COUNTY OF

Los Angeles

JOC TECHNICAL SPECIFICATIONS



JAMB

SERVICES

JAMB Services, Inc.

Technical Specifications

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SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site improvements.
2. Abandoning in-place and/or Removing below-grade construction.
3. Disconnecting, capping or sealing, and/or abandoning in-place or removing site utilities.
4. Salvaging items for reuse by Owner.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.4 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.5 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before building demolition, Owner will remove the following items:

a. Owner will notify Contractor.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site storage or sale of removed items or materials is not permitted.

F. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Perform an engineering survey as directed of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.

2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION

A. General: Demolish as directed buildings and/or site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least 6 hours after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

C. Explosives: Use of explosives is not permitted.

D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

E. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

F. Salvage: Items to be removed and salvaged as directed.

G. Demolish or Abandon foundation walls and other below-grade construction as directed.

1. Remove below-grade construction, including basements, foundation walls, and footings, as directed.

H. Existing Utilities: Demolish or Abandon existing utilities and below-grade utility structures as directed.

I. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

J. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials, recycled pulverized concrete or recycled pulverized masonry as directed.

K. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

L. Promptly repair damage to adjacent buildings caused by demolition operations.

3.6 CLEANING

A. Remove demolition waste materials from Project site as directed

B. Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.4 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.5 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.

2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Perform an engineering survey ,as directed, of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least 6 hours after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 024296 - HISTORIC REMOVAL AND DISMANTLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment procedures in the form of special types of selective demolition work for designated historic spaces, areas, rooms, and surfaces.

1.2 DEFINITIONS

A. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

B. Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.

C. Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Retain: To keep existing items that are not to be removed or dismantled.

E. Salvage: To protect removed or dismantled items and deliver them to Owner ready for reuse.

1.3 QUALITY ASSURANCE

A. Historic Removal and Dismantling Specialist Qualifications: A qualified historic treatment specialist. General selective demolition experience is insufficient experience for historic removal and dismantling work.

B. Removal and Dismantling Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of removal and dismantling work, including protection of surrounding and substrate materials and Project site.

C. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.4 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

    a. In the case of asbestos, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.

D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

    a. In the case of asbestos, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.

E. Hazardous Materials: Hazardous materials are present in construction affected by removal and dismantling work. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials, except under procedures specified elsewhere in the Contract Documents.
3. If unanticipated asbestos is suspected, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.

F. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work.

1. Verify that affected utilities are disconnected and capped.
2. Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage. Enter this information on the submittal of inventory of salvaged items.
3. Engineering Survey: Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures as a result of removal and dismantling work.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and preconstruction video recordings as directed.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."

C. Perform surveys as the Work progresses to detect hazards resulting from historic removal and dismantling procedures.

3.2 HISTORIC REMOVAL AND DISMANTLING

A. General: Have removal and dismantling work performed by a qualified historic removal and dismantling specialist.

B. Perform work according to the historic treatment program.

C. Water-Mist Sprinkling: Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment according to the historic treatment program to ensure that such water does not create a hazard or adversely affect other building areas or materials.

D. Anchorages:

1. Remove anchorages associated with removed items.
2. Dismantle anchorages associated with dismantled items.
3. In nonhistoric surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.
4. In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section that is specific to the historic surface being patched.

END OF SECTION 024296

SECTION 028716.13 - BIRD EXCREMENT REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for bird-excrement removal.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 QUALITY ASSURANCE

A. Bird-Excrement-Removal Specialist Qualifications: A firm that employs personnel experienced and skilled in the processes and operations indicated.

B. Industrial Hygienist Qualifications: Certified as Industrial Hygienist by the American Board of Industrial Hygiene; having Bachelor's degree in industrial hygiene, public health, biological science, occupational health, or environmental and safety discipline; and experienced in work of types specified.

C. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning excrement-removal work. Comply with collection and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 BIRD-EXCREMENT REMOVAL

A. General: Owner will engage a qualified industrial hygienist to perform tests, make recommendations, and observe the work. Follow procedures required by authorities having jurisdiction and recommended by industrial hygienist.

B. Removing Bird Excrement: Have bird-excrement-removal work performed by a qualified bird-excrement-removal specialist. Remove exterior bird-excrement accumulations with building windows and other openings in the building closed or sealed off. Remove interior bird excrement with other parts of the building sealed off from work area and with windows and other openings to exterior areas accessible to the public closed or sealed off.

1. Use only nonmetallic tools, such as plastic spatulas and brushes with natural fiber or nylon bristles.

C. Removing Bird-Excrement Stain: Clean as required in Section pertaining to cleaning substrate material from which bird excrement was removed.

END OF SECTION 028716.13

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer overlays.
6. Polymer sealers.
7. Composite structural reinforcement.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1. Review methods and procedures related to concrete maintenance including, but not limited to, the following:

a. Verify concrete-maintenance specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Coordination with building occupants.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

B. Samples: Cured Samples for each exposed product and for each color and texture specified, in manufacturer's standard size appropriate for each type of work.

C. Samples for Initial Selection: Cured Samples for each exposed product and for each color and texture.

1. Include sets of patching-material Samples in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide representative of the range of concrete colors on the building. Document each Sample with product, mix, and or other information necessary to replicate it.
2. Include sets of Samples for epoxy crack-injection adhesive and capping adhesive in the form of injection-treated, whole, dense concrete block or brick units representative of the range of required adhesive colors.
3. Include sets of polymer-overlay Samples in the form of treated cementitious tiles at least 4 inches (100 mm) long by 4 inches (100 mm) wide representative of the range of required colors and textures.
4. Include sets of polymer-sealer Samples in the form of treated cementitious tiles at least 4 inches (100 mm) long by 4 inches (100 mm) representative of the range of required colors and textures.
5. Have each set of Samples contain a close color range of at least “as directed” Samples of different mixes of materials that match the variations in existing, adjacent concrete when cured and dry.

D. Samples for Verification: Cured Samples for each exposed product and for each color and texture specified.

1. Include Samples of each required type, color, and texture of patching material in the form of patches in drilled holes or sawed joints in sample concrete representative of the range of concrete colors on the building.
2. Include Samples of epoxy crack-injection in the form of injection-treated, whole, dense concrete block or brick units representative of the range of required adhesive colors.
3. Include Samples of each required type, color, and texture of polymer-overlay material in the form of cementitious tiles at least 8 inches (200 mm) long by 8 inches (200 mm) wide.
4. Include Samples of each required type, color, and texture of polymer-sealer material in the form of cementitious tiles at least 8 inches (200 mm) long by 8 inches (200 mm) wide.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For concrete-maintenance specialist and manufacturers.

B. Material Certificates: For each type of portland cement aggregate supplied for mixing or adding to products at Project site.

C. Product Test Reports: For each manufactured bonding agent cementitious patching mortar joint-filler crack-injection adhesive polymer overlay polymer sealer and composite structural reinforcement, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

E. Quality-Control Program: Submit before work begins.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Each manufactured bonding-agent packaged patching-mortar joint-filler crack-injection-adhesive corrosion-inhibiting-treatment polymer-overlay polymer-sealer and composite-structural-reinforcement manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

B. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply packaged patching-mortar crack-injection adhesive corrosion-inhibiting treatments polymer overlays polymer sealers and composite structural reinforcement to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.

1. Field Supervision: Concrete-maintenance specialist firm shall maintain experienced full-time supervisors on Project site during times that concrete-maintenance work is in progress.

C. Quality-Control Program: Prepare a written plan for concrete maintenance to systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.

D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Concrete Removal and Patching: Remove and repair an approximately 50 sq. ft. (4.6 sq. m) approximately 100 sq. in. (645 sq. cm) area of deteriorated concrete deck deteriorated concrete wall.
2. Floor Joint Repair: Cut out and reinstall joints in two separate areas each approximately 48 inches (1200 mm) long as indicated on Drawings, or as directed.
3. Epoxy Crack Injection: Perform epoxy crack injection in two separate areas each approximately 48 inches (1200 mm) long as indicated on Drawings or as directed.
4. Polymer Overlay: Apply an approximately 50 sq. ft. (4.6 sq. m) area of polymer overlay.
5. Polymer Sealer: Apply an approximately 50 sq. ft. (4.6 sq. m) area of polymer sealer.
6. Composite Structural Reinforcement: Apply composite structural reinforcement a minimum of 48 inches (1200 mm) long as indicated on Drawings.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.8 FIELD CONDITIONS

A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.

1. Use only Class A epoxies when substrate temperatures are below or are expected to go below 40 deg F (5 deg C) within eight hours.
2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below 60 deg F (16 deg C) within eight hours.
3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above 60 deg F (16 deg C) for eight hours.

B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 40 deg F (5 deg C) and will remain so for at least 48 hours after completion of Work.

C. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:

1. When air temperature is below 40 deg F (5 deg C), heat patching-material ingredients and existing concrete to produce temperatures between 40 and 90 deg F (5 and 32 deg C).
2. When mean daily air temperature is between 25 and 40 deg F (minus 4 and plus 5 deg C), cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
3. When mean daily air temperature is below 25 deg F (minus 4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.

D. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F (32 deg C) and above.

E. Environmental Limitations for High-Molecular-Weight Methacrylate Sealers: Do not apply when concrete surface temperature is below 55 deg F (13 deg C) or above 75 deg F (24 deg C)90 deg F (32 deg C) or as directed. Apply only to dry substrates substrates that have been dry for at least 72 hours or as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENTS

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

B. Epoxy Bonding Agent: ASTM C881/C881M, bonding system Type II Type V and free of VOCs as directed.

C. Latex Bonding Agent, Redispersible: ASTM C1059/C1059M, Type I for use at nonstructural and interior locations unless otherwise indicated.

D. Latex Bonding Agent, Non-Redispersible: ASTM C1059/C1059M, Type II for use at structural and exterior locations and where indicated.

E. Mortar Scrub Coat: Mix consisting of 1 part portland cement and 1 part fine aggregate complying with ASTM C144 except 100 percent passing a No. 16 (1.18-mm) sieve.

2.3 PATCHING MORTAR

A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar where indicated that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
3. Coarse Aggregate for Patching Mortar: ASTM C33/C33M, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Job-Mixed Patching Mortar: 1 part portland cement and 2-1/2 parts fine aggregate complying with ASTM C144, except 100 percent passing a No. 16 (1.18-mm) sieve.

C. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Compressive Strength: As directed when tested according to ASTM C109/C109M.

D. Rapid-Strengthening, Cementitious Patching Mortar: Packaged, dry mix, ASTM C928/C928M for repair of concrete.

1. Compressive Strength: As directed when tested according to ASTM C109/C109M.

E. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
1. Compressive Strength: As directed when tested according to ASTM C109/C109M.

F. Polymer-Modified, Silica-Fume-Enhanced, Cementitious Patching: Packaged, dry mix for repair of concrete and that contains silica fume complying with ASTM C1240 and a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
1. Compressive Strength: As directed when tested according to ASTM C109/C109M.

2.4 PREPLACED CONCRETE MATERIALS

A. Preplaced Aggregate: Washed aggregate, ASTM C33/C33M, Class 5S, with 95 to 100 percent passing a 1-1/2-inch (37.5-mm) sieve, 40 to 80 percent passing a 1-inch (25-mm) sieve, 20 to 45 percent passing a 3/4-inch (19-mm) sieve, zero to 10 percent passing a 1/2-inch (12.5-mm) sieve, and zero to 2 percent passing a 3/8-inch (9.5-mm) sieve, 100 percent passing a 1-1/2-inch (37.5-mm) sieve, 95 to 100 percent passing a 1-inch (25-mm) sieve, 40 to 80 percent passing a 3/4-inch (19-mm) sieve, zero to 15 percent passing a 1/2-inch (12.5-mm) sieve, and zero to 2 percent passing a 3/8-inch (9.5-mm) sieve.

B. Fine Aggregate for Grout: Fine aggregate according to ASTM C33/C33M, but with 100 percent passing a No. 8 (2.36-mm) sieve, 95 to 100 percent passing a No. 16 (1.18-mm) sieve, 55 to 80 percent passing a No. 30 (0.6-mm) sieve, 30 to 55 percent passing a No. 50 (0.3-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, zero to 10 percent passing a No. 200 (0.075-mm) sieve, and having a fineness modulus of 1.30 to 2.10.

C. Grout Fluidifier for Grout: ASTM C937.

D. Pozzolans for Grout: ASTM C618.

2.5 JOINT FILLER

A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

B. Polyurea Joint Filler: Two-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

C. Color: As directed.

2.6 EPOXY CRACK-INJECTION MATERIALS

A. Epoxy Crack-Injection Adhesive: ASTM C881/C881M, bonding system as directed free of VOCs.
   1. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.
   2. Color: Provide epoxy crack-injection adhesive and capping adhesive as directed.

2.7 CORROSION-INHIBITING MATERIALS

A. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.

2.8 POLYMER-OVERLAY MATERIALS

A. Polymer Overlay: Epoxy adhesive complying with ASTM C881/C881M, bonding system Type III, with surface-applied aggregate for skid resistance; free of VOCs.

B. Aggregate: ACI 503.3, oven-dried, washed silica sand.
   1. Color and Texture: As directed.

2.9 POLYMER-SEALER MATERIALS

A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; free of VOCs (As directed).
   1. Color: As directed.

B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; free of VOCs (As directed).
   1. Color: As directed.

2.10 COMPOSITE REINFORCEMENT MATERIALS

A. Composite Structural Reinforcement: Manufacturer's system consisting of carbon-fiber, glass-fiber or as directed, reinforcement in the form of tow sheet with field-applied saturant, preimpregnated sheet or as directed and epoxy primers, fillers, adhesives, saturants, topcoats or as directed designed for use as externally bonded structural reinforcement for concrete.

2.11 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

B. Water: Potable.

2.12 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

1. Do not add water, thinners, or additives unless recommended by manufacturer.
2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.

B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.

C. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

D. Concrete: Comply with Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."Section 033300 "Architectural Concrete."

E. Grout for Use with Preplaced Aggregate: Proportion according to ASTM C938. Add grout fluidifier to mixing water followed by portland cement, pozzolan, and fine aggregate.

PART 3 - EXECUTION

3.1 CONCRETE-MAINTENANCE SPECIALIST

A. Concrete-Maintenance Specialist Firms: Subject to compliance with requirements.

3.2 CONCRETE MAINTENANCE

A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.

B. Comply with manufacturers' written instructions for surface preparation and product application.

3.3 EXAMINATION

A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.

D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.4 PREPARATION

A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.

B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
2. Use only proven protection methods appropriate to each area and surface being protected.
3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
9. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape or a liquid strippable masking agent. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
10. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
11. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

D. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Verify that affected utilities have been disconnected and capped.
2. Inventory and record the condition of items to be removed for reinstallation or salvage.
3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars as directed until only tightly adhered light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
2. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars.
3. Splice replacement bars to existing bars according to ACI 318 (ACI 318M) by lapping, welding, or using mechanical couplings.

F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, as directed. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

G. Surface Preparation for Corrosion-Inhibiting Treatment: Clean concrete to remove dirt, oils, films, and other materials detrimental to treatment application.

1. As directed.
2. Allow surface to dry before applying corrosion-inhibiting treatment.

H. Surface Preparation for Overlays:

1. Remove delaminated material and deteriorated concrete surface material.
2. Roughen surface of concrete to produce a surface profile matching CSP (As directed) according to ICRI 310.2.
3. Remove as directed.
4. Sweep and vacuum roughened surface to remove debris followed by low-pressure water cleaning.

I. Acidic Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 according to ICRI 310.2. Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.

1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
3. Check acidity of surface with pH test paper and continue rinsing until pH is acceptable according to sealer manufacturer's written instructions.

4. When pH is acceptable according to sealer manufacturer's written instructions and surface is clean, vacuum dry.

J. Nonacidic Surface Preparation for Sealers: Clean concrete to remove dirt, oils, films, and other materials detrimental to sealer application.

1. As directed.

K. Surface Preparation for Composite Structural Reinforcement: Clean concrete where reinforcement and epoxy patching mortar is to be placed by low-pressure water cleaning, detergent scrubbing or as directed to remove dirt, oils, films, and other materials detrimental to epoxy patching mortar.

1. Roughen surface of concrete by sand blasting.
2. Remove delaminated material and deteriorated concrete surface material.
3. Sweep and vacuum roughened surface to remove debris followed by low-pressure water cleaning.

3.5 CONCRETE REMOVAL

A. Do not overload structural elements with debris.

B. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

D. Remove additional concrete if necessary to provide a depth of removal of at least 1/2 inch (13 mm) over entire removal area.

E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch (19-mm) clearance around bar.

F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.

G. Provide surfaces with a fractured profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.

H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.6 BONDING AGENT APPLICATION

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars and concrete by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.

B. Epoxy Bonding Agent: Apply to reinforcing bars and concrete by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat. Place patching mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.

C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.

D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface according to manufacturer's written instructions. Place patching mortar or concrete while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar or concrete.

E. Mortar Scrub Coat for Job-Mixed Patching Mortar and Concrete: Dampen repair area and surrounding concrete 6 inches (150 mm) beyond repair area. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and thoroughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.

F. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar mixed with latex bonding agent into substrate, filling pores and voids.

3.7 PATCHING MORTAR APPLICATION

A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer or where dry-pack mortar is indicated .

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply specified as directed.

C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

D. Vertical Patching: Place material in lifts as directed. Do not feather edge.

E. Overhead Patching: Place material in lifts as directed. Consolidation: After each lift is placed, consolidate material and screed surface.

F. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.

G. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish as directed.

H. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 DRY-PACK-MORTAR APPLICATION

A. Use dry-pack mortar for deep cavities as directed. Place as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: As directed.

C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.

D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.

E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.9 CONCRETE PLACEMENT

A. Place concrete as directed and as specified in this article.

B. Pretreatment: Apply as directed to reinforcement and concrete substrate.

C. Pretreatment: Apply as directed to concrete substrate.

D. Standard Placement: Place concrete by form-and-pump method unless otherwise indicated.

1. Use vibrators to consolidate concrete as it is placed.
2. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.

E. Form-and-Pump Placement: Place concrete by form-and-pump method where indicated.

1. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and where forms abut existing concrete.
2. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi (96 kPa).

F. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.

G. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

3.10 GROUTING PREPLACED AGGREGATE CONCRETE

A. Use grouted preplaced aggregate concrete where indicated for column and wall repairs. Place as specified in this article.

B. Design and construct forms to resist pumping pressure in addition to weight of wet grout. Seal joints and seams in forms and where forms abut existing concrete.

C. Apply as directed to reinforcement and concrete substrate.

D. Place aggregate in forms, consolidating aggregate in lifts as it is placed. Pack aggregate into upper areas of forms to achieve intimate contact with concrete surfaces.

E. Fill forms with water to thoroughly dampen aggregate and substrates. Drain water from forms before placing grout.

F. Pump grout into place at bottom of preplaced aggregate, forcing grout upward. Release air from forms at top as grout is introduced. When formed space is full and grout flows from air vents, close vents and pressurize to 14 psi (96 kPa).

G. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.

H. Repair voids with patching mortar and finish to match surrounding concrete.

3.11 FLOOR-JOINT REPAIR

A. Cut out deteriorated concrete and reconstruct sides of joint with patching mortar requirement as as directed. Install joint filler in nonmoving floor joints where indicated and as specified in this article.

B. Depth: Install joint filler to a depth as directed. Use fine silica sand no more than 1/4 inch (6 mm) deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.

C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.12 EPOXY CRACK INJECTION

A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.

B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.

C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.

D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.

E. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm).

F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.

G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.13 CORROSION-INHIBITING-TREATMENT APPLICATION

A. Apply corrosion-inhibiting treatment as directed and extent where treatment shall be applied.

B. Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment by high-pressure washing before patching treated concrete as directed.

3.14 POLYMER OVERLAY APPLICATION

A. Apply polymer overlay according to ACI 503.3.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.15 POLYMER SEALER APPLICATION

A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.16 COMPOSITE STRUCTURAL REINFORCEMENT APPLICATION

A. Fiber Tow Sheet and Saturant: Unless otherwise recommended by manufacturer, install as follows:

1. Apply epoxy primer using brush or short nap roller to prepared concrete surfaces in areas where composite structural reinforcement will be applied.
2. After primer has set, patch surface defects with epoxy filler and allow to set before beginning reinforcement application.
3. Apply epoxy saturant to fiber tow sheet or primed and patched surface, or as directed using roller. Apply fiber tow sheet to primed and patched surface while saturant is still

wet, using pressure roller to remove air pockets. Remove paper backing from fiber tow sheet and apply additional epoxy to fully saturate tow sheet.
4. Apply additional layers using same procedure, fully saturating each layer with epoxy.
5. After saturant has cured, apply protective topcoat as directed.

B. Preimpregnated Fiber Sheet: Unless otherwise recommended by manufacturer, install as follows:

1. Patch surface defects with epoxy mortar and allow to set before beginning reinforcement application.
2. Apply epoxy adhesive to a thickness of 1/16 inch (1.6 mm) to prepared concrete surfaces.
3. Clean fiber sheet with acetone or other suitable solvent, and apply epoxy adhesive to a thickness of 1/16 inch (1.6 mm).
4. Apply adhesive-coated fiber sheet to adhesive-coated concrete and roll with a hard rubber roller until fiber sheet is fully embedded in adhesive, air pockets are removed, and adhesive is forced out from beneath fiber sheet at edges.
5. Apply additional layers using same procedure.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Packaged, Cementitious Patching Mortar: As directed randomly selected sets of samples for each type of mortar required, tested according to ASTM C928/C928M.
2. Job-Mixed Patching Mortar: As directed randomly selected sets of samples for each type of mortar required, tested for compressive strength according to ASTM C109/C109M.
3. Concrete: As specified in Section 033000 "Cast-in-Place Concrete.", Section 033053 "Miscellaneous Cast-in-Place Concrete.", Section 033300 "Architectural Concrete."
4. Grout for Preplaced Aggregate: Tested for compressive strength according to ASTM C942.

    a. Testing Frequency: One sample for each 25 cu. yd. (19 cu. m) of grout or fraction thereof, but not less than one sample for each day's work.

5. Joint Filler: Core-drilled samples to verify proper installation.

    a. Testing Frequency: One sample for each 100 feet (30 m) of joint filled.
    b. Where samples are taken, refill holes with joint filler.

6. Epoxy Crack Injection: Core-drilled samples to verify proper installation.

    a. Testing Frequency: Three samples from mockup and one sample for each 100 feet (30 m) of crack injected.
    b. Where samples are taken, refill holes with epoxy mortar.

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Manufacturers Field Service: Engage manufacturers' factory-authorized service representatives for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

1. Have manufacturers' factory-authorized service representatives perform the following number of Project-site inspections to observe progress and quality of the Work, distributed over the period of product installation, regardless of on-site assistance requested by Architect:

a. Bonding-Agent and Packaged Patching-Mortar Installation: Three inspections.
b. Joint-Filler Installation: Two inspections.
c. Crack-Injection-Adhesive Preparation and Installation: Four inspections.
d. Corrosion-Inhibiting Treatment: Two inspections.
e. Polymer Overlay: Two inspections.
f. Polymer Sealer: Two inspections.
g. Composite-Structural-Reinforcement: Three inspections.

3.18 CONCRETE MAINTENANCE SCHEDULE

A. Garage Level 1 Entrance Ramp: Perform the following as indicated on Drawings:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer overlays.
6. Polymer sealers.
7. Composite structural reinforcement on underside of slab.

B. Elevated Warehouse Floors: Perform the following as indicated on Drawings:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer overlays.
6. Polymer sealers.
7. Composite structural reinforcement on underside of slab.

C. Concrete Walls and Floor in Salt Dome: Perform the following as indicated on Drawings:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer overlays.
6. Polymer sealers.
7. Composite structural reinforcement of columns.

END OF SECTION 030130

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 035300 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.
5. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As Directed.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

F. Samples: For waterstops or vapor retarder or “as directed”.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.

8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

E. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Galvanized Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), ASTM A706/A706M, deformed bars, ASTM A767/A767M, Class I or Class II zinc coated after fabrication and bending.

D. Epoxy-Coated Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), ASTM A706/A706M, deformed bars, ASTM A775/A775M or ASTM A934/A934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

E. Stainless-Steel Reinforcing Bars: ASTM A955/A955M, Grade 60 (Grade 420), Type 304 or Type 316L, or as directed, deformed.

F. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 (Grade 420) ASTM A706/A706M, deformed bars, assembled with clips.

G. Plain-Steel Wire: ASTM A1064/A1064M, as directed.

H. Deformed-Steel Wire: ASTM A1064/A1064M.

I. Epoxy-Coated Wire: ASTM A884/A884M, Class A, Type 1 coated, as directed, deformed-steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.

J. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

K. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

L. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

M. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, plain or deformed steel, as directed.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, ASTM A775/A775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

D. Zinc Repair Material: ASTM A780/A780M.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, as directed.

2. Retain supplementary cementing materials in "Fly Ash" and "Slag Cement" subparagraphs below if permitted. Ready-mix-concrete manufacturer blends these materials with portland cement. Fly ash, slag cement, or pozzolanic materials may slow rate of concrete strengthening and affect color uniformity. Class F fly ash is more readily available than Class C fly ash.
3. Fly Ash: ASTM C618, Class F or C or as directed.
4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C595/C595M, cement as directed.
6. Silica Fume: ASTM C1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded as directed. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: (As directed) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, (As directed) nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.

H. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

I. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As directed.

J. Water: ASTM C94/C94M and potable.

2.6 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A820/A820M, Type 1, cold-drawn wire, deformed, minimum of “as directed” long, and aspect ratio of “as directed”.

B. Carbon-Steel Fiber: ASTM A820/A820M, Type 2, cut sheet, deformed, minimum of “as directed” long, and aspect ratio “as directed”.

C. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, “as directed” long.

D. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, “as directed” long.

E. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, “as directed” long.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: As directed.
   2. Dimensions: As directed; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
   1. Profile: As directed.
   2. Dimensions: As directed; nontapered.

C. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: As directed.
   2. Dimensions: As directed; nontapered.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A, except with maximum water-vapor permeance of “as directed”. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Sheet Vapor Retarder: ASTM E1745, Class B, except with maximum water-vapor permeance of “as directed” Include manufacturer's recommended adhesive or pressure-sensitive tape.

C. Sheet Vapor Retarder: ASTM E1745, Class C, except with maximum water-vapor permeance. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

D. Sheet Vapor Retarder: Polyethylene sheet, ASTM D4397, not less than 10 mils (0.25 mm) thick.

E. Bituminous Vapor Retarder: 110-mil- (2.8-mm-) thick, semiflexible, seven-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective

weathercoating, and removable plastic release liner. Furnish manufacturer's accessories, including bonding asphalt, pointing mastics, and self-adhering joint tape.

1. Water-Vapor Permeance: 0.0011 grains/h x sq. ft. x inches Hg (0.063 ng/Pa x s x sq. m); ASTM E154.
2. Tensile Strength: 140 lbf/inch (24.5 kN/m); ASTM E154.
3. Puncture Resistance: 90 lbf (400N); ASTM E154.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing as directed, Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

B. Emery Dry-Shake Floor Hardener: Pigmented or Unpigmented as directed, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: As directed.

C. Metallic Dry-Shake Floor Hardener: Pigmented or Unpigmented, as directed, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As directed.

D. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

E. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

F.

1. Color: As directed.

2.10 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.12 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork and as directed.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 and as directed according to ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. As directed for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C109/C109M.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.

4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to “as directed” percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use “as directed” admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed.
3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture , plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed.
3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed.
3. Minimum Cementitious Materials Content: As directed.
4. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
8. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (29.7 kg/cu. m).
9. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m) 1.5 lb/cu. yd. (0.90 kg/cu. m).
10. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd. (2.4 kg/cu. m) or 5 lb/cu. yd. (3 kg/cu. m) and as directed.

D. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed.
3. Minimum Cementitious Materials Content: As directed.
4. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm), 3/4-inch (19-mm) nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
8. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (29.7 kg/cu. m).
9. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m) 1.5 lb/cu. yd. (0.90 kg/cu. m) and as directed.
10. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd. (2.4 kg/cu. m) or 5 lb/cu. yd. (3 kg/cu. m) and as directed.

E. Suspended Slabs: Lightweight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Calculated Equilibrium Unit Weight: As directed plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C567/C567M.

3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture , plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch (10 mm).
5. Air Content: 7 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size 3/8 inch (10 mm) or less.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (29.7 kg/cu. m).
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m) or 1.5 lb/cu. yd. (0.90 kg/cu. m) and as directed.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd. (2.4 kg/cu. m) or 5 lb/cu. yd. (3 kg/cu. m) and as directed.

F. Concrete Toppings: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Minimum Cementitious Materials Content: As directed.
3. Slump Limit: As directed, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.
6. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.
7. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (29.7 kg/cu. m).
8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m) or 1.5 lb/cu. yd. (0.90 kg/cu. m) and as directed.
9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd. (2.4 kg/cu. m) or 5 lb/cu. yd. (3 kg/cu. m) and as directed.

G. Building Frame Members: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed .
3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.

H. Building Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As directed at 28 days.

2. Maximum W/C Ratio: As directed
3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture , plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.

2.16 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.

2. As directed for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer or not chamfer as directed exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A780/A780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as directed. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth or as directed of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view as directed.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces as directed.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces as directed.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces as directed.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces as directed.

2. Finish surfaces to the following tolerances, according to ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
    d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed “as directed”.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule or as directed finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate or aluminum granules or as directed over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules as directed.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases “as directed” high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: “as directed” at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than “as directed” days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least “as directed” month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color.

Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M, pressure method, for normal-weight concrete; ASTM C173/C173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C567/C567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31/C31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E1155 (ASTM E1155M) within 24 or 48 and “as directed” hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
2. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. Comply with the following sections of ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."

3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."
6. "Lightweight Concrete."

B. Comply with ACI 117 (ACI 117M).

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.3 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, As directed

2. Retain supplementary cementing materials in "Fly Ash" and "Slag Cement" subparagraphs below if permitted. Ready-mix-concrete manufacturer blends these materials with portland cement. Fly ash, slag cement, or pozzolanic materials may slow rate of concrete strengthening and affect color uniformity.
3. Fly Ash: ASTM C618, Class C or F.
4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C595/C595M, cement (As directed).

C. Normal-Weight Aggregate: ASTM C33/C33M, 1-1/2-inch (38-mm) nominal maximum aggregate size.

D. Lightweight Aggregate: ASTM C330/C330M, 1-inch (25-mm) nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Water: ASTM C94/C94M.

2.4 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament or fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

2.5 RELATED MATERIALS

A. Vapor Retarder: Plastic sheet, ASTM E1745, Class A or B.

B. Vapor Retarder: Polyethylene sheet, ASTM D4397, not less than 10 mils (0.25 mm) thick; or plastic sheet, ASTM E1745, Class C.

C. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.

F. Clear, Waterborne or Solvent-Borne as directed, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 CONCRETE MIXTURES

A. Comply with ACI 301 (ACI 301M).

B. Normal-Weight Concrete:

1. Minimum Compressive Strength: As directed at 28 days.
2. Maximum W/C Ratio: As directed.

3. Cementitious Materials: Use fly ash, pozzolan, slag cement, and blended hydraulic cement as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
4. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

C. Structural Lightweight Concrete Mix: ASTM C330/C330M, proportioned to produce concrete with a minimum compressive strength of 3000 psi (20.7 MPa) at 28 days and a calculated equilibrium unit weight of 110 lb/cu. ft. (1762 kg/cu. m) plus or minus 3 lb/cu. ft. (48.1 kg/cu. m), as determined by ASTM C567/C567M. Concrete slump at point of placement shall be the minimum necessary for efficient mixing, placing, and finishing.

1. Limit slump to 5 inches (125 mm) for troweled slabs and 4 inches (100 mm) for other slabs.

D. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than a rate of 1.0 lb/cu. yd. (0.60 kg/cu. m) or 1.5 lb/cu. yd. (0.90 kg/cu. m), as directed.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and ASTM C1116/C1116M and furnish batch ticket information.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

A. Install, protect, and repair vapor retarders according to ASTM E1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 (ACI 301M) for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

E. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases: As directed high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: As directed at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch (13 mm).

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm).

1. Apply to concrete surfaces as directed. .

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-rubbed finish.
2. Grout-cleaned finish.
3. Cork-floated finish.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed

surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes unless otherwise indicated.

D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Slip-Resistive Broom Finish: Apply a slip-resistive finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301 (ACI 301M).

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

END OF SECTION 033053

SECTION 033300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1. Requirements in Section 033000 "Cast-in-Place Concrete" apply to architectural concrete.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Cast-in-place architectural concrete Subcontractor.

2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete as directed.
3. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.

F. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Form liners.
4. Exposed aggregates.
5. Coarse- and fine-aggregate gradations.
6. Chamfers and rustications.

G. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer or testing agency as directed.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Repair materials.

C. Material Test Reports: For the following, by a qualified testing agency:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove field sample panels when directed.

D. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301 (ACI 301M).
2. ACI 303.1.

2.2 FORM-FACING MATERIALS

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.

C. Form-Facing Panels for As-Cast or Exposed-Aggregate as directed, Finishes: Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

D. Form-Facing Panels for As-Cast or Exposed-Aggregate as directed, Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better or medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1, or Finnish phenolic overlaid birch plywood or as directed.

E. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that provide surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

F. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

G. Form Liners: Units of face design, texture, arrangement, and configuration indicated to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

H. Rustication Strips: Metal, dressed wood, or rigid plastic, or with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

I. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths.

J. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch (6 mm) thick.

K. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS, that adheres to form joint substrates.

L. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

M. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

N. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.

O. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic, internally disconnecting, removable or as directed ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

   1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes as directed in diameter on concrete surface.
   2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm), after exposing aggregate, from the architectural concrete surface.
   3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color to match Architect's sample, selected by Architect from manufacturer's full range or as directed.
   4. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."

   1. Where legs of wire bar supports contact forms, use “as directed” bar supports.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

   1. Portland Cement: ASTM C150/C150M, As directed.

2. Fly Ash: ASTM C618, Class C, Class F or as directed.
3. Slag Cement: ASTM C989/C989M, Grade 100 or Grade 120.
4. Silica Fume: ASTM C1240 amorphous silica.
5. Blended Hydraulic Cement: ASTM C595/C595M, cement (as directed).

C. Normal-Weight Aggregates: ASTM C33/C33M, As directed coarse aggregate or better, graded. Provide aggregates from single source with documented service-record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: As directed.
2. Gradation: Uniformly, Gap or as directed graded.

D. Normal-Weight Fine Aggregate: ASTM C33/C33M or ASTM C144, manufactured or natural sand, from same source for entire Project.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that does not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Color: As directed.

H. Water: Potable, complying with ASTM C94/C94M, except free of wash water from mixer washout operations.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.
1. For integrally colored concrete, curing compound shall be pigmented type approved by color pigment manufacturer.

2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C881/C881M two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
1. Types I and II, nonload bearing, Types IV and V, load bearing, or as directed for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 (ACI 301M) requirements. Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent or as directed.

D. Limit water-soluble, chloride-ion content in hardened concrete as directed percent by weight of cement.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

G. Concrete Mixtures:

1. Compressive Strength (28 Days): As directed.
2. Maximum W/C Ratio: 0.46.
3. Slump Limit: As directed for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).

4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) or 3/4-inch (19-mm) nominal maximum aggregate size.

2.8 CONCRETE MIXING

A. Ready-Mixed or Site-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm), Class B, 1/4 inch (6 mm), Class C, 1/2 inch (13 mm), or as directed.

D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ASI 117M).

1. Also comply with the following tolerances: as directed.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer, Do not chamfer or exterior corners and edges of cast-in-place architectural concrete as directed.

H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERT INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved field sample panels or mockups as directed.
2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength at least 70 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated.Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use bonding agent or epoxy-bonding adhesive as directed at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair or Do not repair as directed and patch tie holes and defects.

C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches

adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.8 EXPOSED-AGGREGATE FINISHES

A. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi (6.9 to 10.3 MPa), apply scrubbed finish. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed. Rinse scrubbed surfaces with clean water. Maintain continuity of finish on each surface or area of Work. Remove only enough concrete mortar from surfaces to match design reference sample or mockup.

B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi (31 MPa). Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.

1. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.

C. Abrasive-Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi (13.8 MPa). Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.

1. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample or mockup.
2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:

    a. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
    b. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch (1.5 mm).
    c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/4 inch (6 mm).
    d. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 1/2 inch (6 to 13 mm).

D. Bushhammer Finish: Allow concrete to cure at least 14 days before starting bushhammer surface finish operations.

1. Surface Continuity: Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match design reference sample or mockup.
2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
3. Remove impressions of formwork and form facings with exception of tie holes.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from or applying as-cast formed finishes to concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Section 033000 "Cast-in-Place Concrete."

3.11 REPAIR, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033300

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes polished concrete finishing, including staining and scoring.

1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.3 DEFINITIONS

A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Cast-in-place concrete subcontractor.
e. Polished concrete finishing Subcontractor.

2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete as directed.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

D. Samples for Initial Selection: For each type of product requiring color selection.

E. Samples for Verification: For each type of exposed color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.
2. Stain materials.
3. Liquid floor treatments.

1.7 QUALITY ASSURANCE

A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches (1200 by 1200 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove field sample panels when directed.

B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Demonstrate curing, finishing, and protecting of polished concrete.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 STAIN MATERIALS

A. Reactive Stain: Acidic-based stain with wetting agents and high-grade, UV-stable metallic salts that react with calcium hydroxide in cured concrete to produce permanent, variegated, or translucent color effects.

1. As directed.

B. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments.

1. As directed.

2.2 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. As directed.

PART 3 - EXECUTION

3.1 POLISHING

A. Polish: As directed.

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
6. Control and dispose of waste products produced by grinding and polishing operations.

7. Neutralize and clean polished floor surfaces.

3.2 STAINING

A. Newly placed concrete shall be at least 14 or 30 and as directed days old before staining.

B. Prepare surfaces according to manufacturer's written instructions and as follows:

1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.

    a. Do not use acidic solutions to clean surfaces.

2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces as directed. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between 7 or 8 as directed.

C. Scoring: Score decorative jointing in concrete surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score after or before as directed staining.

1. Joint Width: 3/8 inch (10 mm).

D. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D4263 by tightly taping 18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.

E. Reactive Stain: Apply reactive stain to concrete surfaces according to manufacturer's written instructions and as follows:

1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.

F. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:

1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

END OF SECTION 033543

SECTION 033713 - SHOTCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes dry-mix and wet-mix shotcrete.

1.3 DEFINITIONS

A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.

B. Dry-Mix Shotcrete: Shotcrete with most of the mixing water added at nozzle.

C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1. Require representatives of each entity directly concerned with shotcrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for shotcrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Shotcrete Installer.

2. Review methods and procedures related to shotcrete, but not limited to, the following:

    a. Qualification data, equipment, and facilities needed to make progress and avoid delays.
    b. Shotcrete finishes and finishing.
    c. Cold- and hot-weather shotcreting procedures.
    d. Curing procedures
    e. Construction joints.
    f. Forms and form-removal limitations.
    g. Reinforcement accessory installation.
    h. Shotcrete repair procedures.
    i. Protection of shotcrete.

3. Before submitting design mixtures, review each shotcrete design mixture and examine procedures for ensuring quality of shotcrete materials.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.

B. Sustainable Design Submittals:

1. As directed.

C. Design Mixtures: For each shotcrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. For predampened dry-mix mixtures, indicate amounts of mixing water to be added to the dry-mix materials before mixing and conveying through the delivery hose.

D. Shop Drawings: For shotcrete installation.

1. Include plans, elevations, sections, and support and anchor details.
2. Detail fabrication, bending, and placing of reinforcement; number and location of splices; and special reinforcement required for openings through shotcrete structures.
3. Detail formwork fabrication, assembly, and support.
4. Indicate locations of proposed construction joints.

E. Samples: For waterstops, approximately 24 inches (600 mm) long and each exposed product and for each color and finish specified, approximately 24 by 24 by 2 inches (600 by 600 by 50 mm) in size as directed.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, testing agency and preconstruction testing service as directed.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.

C. Preconstruction Test Reports: For shotcrete.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer employing nozzle operators for Project, each of whom attains mean core grades not exceeding 2.5, according to ACI 506.2, on preconstruction tests is ACI Shotcrete Nozzleman certified in Dry-Mix Process for Vertical Position is ACI Shotcrete Nozzleman certified in Dry-Mix Process for Vertical and Overhead Positions is ACI Shotcrete Nozzleman certified in Wet-Mix Process for Vertical Position and is ACI Shotcrete Nozzleman certified in Wet-Mix Process for Vertical and Overhead Positions as appropriate to the required shotcrete work.

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

C. Standard: Comply with ACI 506.2, "Specification for Shotcrete," unless otherwise indicated.

D. Shotcrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design shotcrete mixtures.

E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each finish required and for each design mixture, shooting orientation, and nozzle operator.
2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
3. Demonstrate curing and protecting of shotcrete, finishes, and joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each color and finish, and demonstrate materials and techniques proposed for repair of holes and surface blemishes to match adjacent undamaged surfaces.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage or Engage as directed a qualified testing agency to perform preconstruction testing on shotcrete.

1. Produce and test shotcrete test panels before shotcrete placement according to requirements in ACI 506.2 for each design mixture, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 3-1/2 inches (90 mm).
2. From each test panel, testing agency shall obtain six test specimens: one set of three specimens unreinforced, and one set of three specimens reinforced. Agency will perform the following:

    a. Strength Testing: Test each set of unreinforced specimens for compressive strength according to ASTM C42/C42M.

b. Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms: Form-facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practical sizes to minimize number of joints.

2.2 REINFORCING MATERIALS

A. As directed.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

D. Galvanized Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420) ASTM A706/A706M, deformed bars, ASTM A767/A767M, Class I or Class II zinc coated after fabrication and bending, as directed.

E. Plain-Steel Wire: ASTM A1064/A1064M, as directed.

F. Welded Wire Reinforcement: ASTM A1064/A1064M, as directed, furnished in flat sheet.

G. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice" and as follows:

1. For uncoated reinforcement, use all-plastic, CRSI Class 1, plastic-protected or CRSI Class 2, stainless-steel, as directed bar supports.
2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire or all-plastic as directed bar supports.

H. Reinforcing Anchors: ASTM A36/A36M, unheaded rods or ASTM A307, Grade A, hex-head bolts; carbon steel; and carbon-steel nuts.

1. Finish: As directed, ASTM A153/A153M.

I. Zinc Repair Material: ASTM A780/A780M, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.3 SHOTCRETE MATERIALS

A. As directed.

B. Portland Cement: ASTM C150/C150M, Type I or Type III. Use only one brand and type of cement for Project.

1. Fly Ash: ASTM C618, Class C or Class F.
2. Slag Cement: ASTM C989/C989M, Grade 100 or Grade 120.
3. Silica Fume: ASTM C1240, amorphous silica.

C. Blended Hydraulic Cement: ASTM C595/C595M, cement as directed.

D. Normal-Weight Aggregates: ASTM C33/C33M, from a single source, and as follows:

1. Combined Aggregate Size: ACI 506R or ASTM C1436, Grading No. 1 or No. 2 as directed sieve analysis.
2. Deleterious Substances: As directed according to ASTM C33/C33M.

E. Lightweight Aggregates: ASTM C330/C330M.

1. Combined Aggregate Size: ACI 506R, Grading No. 1 or No. 2 sieve analysis.

F. Water: Potable, complying with ASTM C94/C94M, and free from deleterious materials that may affect color stability, setting, or strength of shotcrete.

G. Carbon-Steel Fiber: ASTM A820/A820M, Type I, cold-drawn wire or Type II, cut sheet, deformed.

1. Nominal Length: As directed.
2. Aspect Ratio: As directed.

H. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in shotcrete, complying with ASTM C1116/C1116M, Type III, 1 to 1.5 inches (25 to 38 mm) 1.5 to 2 inches (38 to 50 mm) long.

I. Ground Wire: High-strength steel wire, 0.8 to 1.0 mm in diameter.

J. Joint Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

K. Admixtures: ASTM C1141/C1141M, Class A (liquid) or Class B (nonliquid), but limited to the following admixture materials. Provide admixtures for shotcrete that contain no more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.

1. Accelerating Admixture, Conventional: ASTM C494/C494M, Type C or Type E.

2. Pozzolanic Admixture: Fly ash, slag cement, and silica fume as limited in "Portland Cement" Paragraph in this article.
3. Coloring Admixture: ASTM C979/C979M, synthetic mineral-oxide pigment or colored, water-reducing admixture, free of carbon black; color stable, nonfading, and resistant to lime and other alkalis.
4. Air-Entraining Admixture: As limited in "Shotcrete Mixtures" Article.

2.4 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell without center bulb or Ribbed without center bulb, As directed.
2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick); nontapered.

B. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Flat dumbbell without center bulb or Ribbed without center bulb, As directed.
2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick); nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete; 3/8 by 3/4 inch (10 by 19 mm).

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry, or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Curing Compound: ASTM C309, Type 1, Class B; clear, waterborne or solvent-borne, as directed membrane-forming curing compound.

2.6 SHOTCRETE MIXTURES

A. Source Limitations for Shotcrete: Obtain each color, size, type, and variety of shotcrete material and shotcrete mixture from single manufacturer with resources to provide shotcrete of consistent quality in appearance and physical properties.

B. Design Mixtures: Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixture or field test data, or both.

C. Cementitious Materials Replacing Portland Cement: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

D. Cementitious Materials, Maximum Content: Limit use as directed, to not exceed, in combination, 25 percent of portland cement by weight.

E. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301 (ACI 301M).

F. Admixtures: Use admixtures according to manufacturer's written instructions.

G. Coloring Admixture: Add coloring admixture to shotcrete mixture according to manufacturer's written instructions and to result in hardened shotcrete color consistent with approved mockup.

H. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

I. Shotcrete Mixture as directed : Proportion mixture to provide shotcrete with the following properties:

1. Compressive Strength (28 Days): As directed.
2. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight wet-mix shotcrete having an air content before pumping of 7 or 8 , as directed percent with a tolerance of plus or minus 1-1/2 percent.
3. Carbon-Steel Fiber: Uniformly disperse in shotcrete mix, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd. (30 kg/cu. m) or 100 lb/cu. yd. (60 kg/cu. m), as directed.
4. Synthetic Fiber: Uniformly disperse in shotcrete mix, according to manufacturer's written instructions, at a rate of 1.5 lb/cu. yd. (0.90 kg/cu. m) or 5 lb/cu. yd. (3 kg/cu. m**)** as directed.
5. Color: As directed. Retain "Color of (Flash) (Finish) Coat" Subparagraph below if color requirement is different from base shotcrete and surface will not be painted.
6. Color of Flash or Finish Coat: As directed, Insert paragraphs for other performance criteria, such as flexural strength and toughness values for fiber-reinforced shotcrete, or for absorption, if required.

2.7 SHOTCRETE EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.

B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.

1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.

C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.8 BATCHING AND MIXING

A. Dry-Mix Process: Measure mixture proportions by weight batching according to ASTM C94/C94M or by volume batching complying with ASTM C685/C685M requirements.

1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
2. Prepackaged shotcrete materials may be used at Contractor's option. Predampen prepackaged shotcrete materials and mix before use.

B. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C94/C94M and ASTM C1116/C1116M and furnish batch ticket information.

1. Comply with ASTM C685/C685M when shotcrete ingredients are delivered dry and proportioned and mixed on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete and Masonry Substrates: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces to saturated, surface-dry condition before shotcreting.

1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.

B. Earth Substrates: Compact and trim to line and grade before placing shotcrete. Do not place shotcrete on frozen surfaces. Dampen surfaces to saturated, surface-dry condition before shotcreting.

C. Rock Substrates: Clean rock surfaces of loose materials, mud, and other foreign matter that might weaken shotcrete bonding. Dampen surfaces to saturated, surface-dry condition before shotcreting.

D. Steel Substrates: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 FORMS

A. General: Design, erect, support, brace, and maintain forms, according to ACI 301 (ACI 301M), to support shotcrete and construction loads and to facilitate shotcreting. Construct forms so shotcrete members and structures are secured to prevent excessive vibration or deflection during shotcreting.

1. Fabricate forms to be readily removable without impact, shock, or damage to shotcrete surfaces and adjacent materials.
2. Construct forms to required sizes, shapes, lines, and dimensions using ground wires and depth gages to obtain accurate alignment, location, and grades in finished structures. Construct forms to prevent mortar leakage but permit escape of air and rebound during shotcreting. Provide for openings, offsets, blocking, screeds, anchorages, inserts, and other features required in the Work.

B. Form openings, chases, recesses, bulkheads, keyways, and screeds in formwork. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

C. Securely embed reinforcing anchors into existing substrates, located as required.

D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports, bolsters, chairs, spacers, and other devices as required to maintain minimum concrete cover.

E. Set wire ties with ends directed into shotcrete, not toward exposed shotcrete surfaces.

F. Install welded wire reinforcement in largest practical sheets on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A780/A780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.4 JOINTS

A. General: Construct joints at locations indicated or as approved by Architect.

B. Construction Joints: Locate and install construction joints tapered to a 1:1 slope where joint is not subject to compression loads and square where joint is perpendicular to main reinforcement. Continue reinforcement through construction joints unless otherwise indicated.

C. Contraction Joints: Construct contraction joints in shotcrete using saw cuts 1/8-inch- (3-mm-) wide by one-third of slab depth or joint-filler strips 1/4-inch- (6-mm-) wide by one-third of shotcrete depth unless otherwise indicated.

1. After shotcrete has cured, remove strip inserts and clean groove of loose debris.
2. Space joints at 15 feet (4.5 m) o.c. horizontally and vertically.
3. Tool edges round on each side of strip inserts if floated or troweled finishes are required.
4. Where shooting over an existing substrate joint, align new shotcrete joint with existing joint.

3.5 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

C. Prevent waterstop displacement during shotcrete application.

3.6 ALIGNMENT CONTROL

A. Ground Wires: Install ground wires to establish thickness and planes of shotcrete surfaces. Install ground wires at corners and offsets not established by forms. Pull ground wires taut and position adjustment devices to permit additional tightening.

3.7 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by shotcrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.8 APPLICATION

A. Apply shotcrete applied by dry-mix or wet-mix process and according to ACI 506.2.

B. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.

C. Moisten wood forms immediately before placing shotcrete where form coatings are not used.

D. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.

E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.

1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
2. Remove and dispose of cuttings during the trimming or rodding process to prevent unconsolidated material from falling onto lower reinforcement.

F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray, and prevent buildup against front face during shotcreting.

G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.

H. Do not permit shotcrete to sag, slough, or dislodge.

I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.

J. Do not disturb shotcrete surfaces before beginning finishing operations.

K. Remove ground wires or other alignment-control devices after shotcrete placement.

L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.

M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117 (ACI 117M), increased by a factor of two.

N. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1 and as follows. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Discontinue shotcreting when ambient temperature is 40 deg F (4.4 deg C) and falling.
2. Uniformly heat water and aggregates before mixing to obtain a shotcrete shooting temperature of not less than 50 deg F (10 deg C) and no more than 90 deg F (32 deg C).
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents.

O. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 305.1 when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:

1. Cool ingredients before mixing to maintain, at time of placement, shotcrete temperature below 100 deg F (38 deg C) for dry mix and 90 deg F (32 deg C) for wet mix.
2. Reduce temperature of reinforcing steel and receiving surfaces below 100 deg F (38 deg C) before shotcreting.

3.9 SURFACE FINISHES

A. General: Finish shotcrete according to descriptions in ACI 506R.

B. Natural Finishes:

1. Gun Finish: Natural undisturbed finish as sprayed.
2. Rod Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set. Do not push or float with flat part of trowel.
3. Broom Finish: Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set; followed by uniform brooming.

C. Flash-Coat Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch (6-mm) coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve to provide a finely textured finish.

D. Flash-Coat with Final Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply up to 1/4-inch (6-mm) coat of shotcrete using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve, and apply as directed finish.

E. Finish-Coat Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply shotcrete finish coat, 1/4 to 1 inch (6 to 25 mm) thick, using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve to provide a finish of uniform texture and appearance.

F. Finish-Coat with Final Finish: After screeding or cutting exposed face of shotcrete to plane after initial set, apply shotcrete finish coat, 1/4 to 1 inch (6 to 25 mm) thick, using ACI 506R, Grading No. 1, fine-screened sand modified with maximum aggregate size not exceeding No. 4 (4.75-mm) sieve, and apply as directed finish.

3.10 CURING

A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.

B. Begin curing immediately after placing and finishing but not before free water, if any, has disappeared from shotcrete surface.

C. Curing Exposed Surfaces: Cure shotcrete by one of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Water-saturated absorptive covers or moisture-retaining covers. Lap and seal sides and ends of covers with 12-inch (300-mm) lap over adjacent covers.

2. Curing Compound: Apply uniformly in continuous operation by power spray according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Apply curing compound to natural gun and flash-coat finishes at rate of 1 gal./100 sq. ft. (1 L/2.5 sq. m).

D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.11 FORM REMOVAL

A. Forms not supporting weight of shotcrete may be removed after curing for 24 consecutive hours at not less than 50 deg F (10 deg C), provided shotcrete is hard enough not to be damaged by form-removal operations and provided curing and protecting operations are maintained.

1. Leave forms supporting weight of shotcrete in place until shotcrete has attained design compressive strength. Determine compressive strength of in-place shotcrete by testing representative field-cured specimens of shotcrete.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are unacceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Air Content: ASTM C173/C173M, volumetric method or ASTM C231/C231M, pressure method; one test for each compressive-strength test for each mixture of air-entrained, wet-mix shotcrete measured before pumping.

C. Shotcrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.

D. Test Panels: Make a test panel, reinforced as in structure, for each shotcrete mixture and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Produce test panels with dimensions of 24 by 24 inches (600 by 600 mm) minimum and of average thickness of shotcrete, but not less than 4-1/2 inches (115 mm). Testing agency will obtain sets of test specimens from each test panel.

1. Compressive Strength Testing: One set of three unreinforced specimens. Test each set of unreinforced specimens for compressive strength according to construction testing requirements in ACI 506.2.
2. Visual Core Grading: One set of three reinforced specimens. Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

E. In-Place Shotcrete Testing: One set of three unreinforced cores for each mixture and for each workday or for every 50 cu. yd. (38 cu. m) of shotcrete placed, whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C42/C42M. Do not cut steel reinforcement.

F. Strength of shotcrete will be considered satisfactory according to the following:

1. Specimen Cores: Mean compressive strength of each set of three unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
2. Specimen Cubes: Mean compressive strength of each set of three unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

G. Shotcrete will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

3.13 REPAIRS

A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.

1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs.
2. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch (13 mm) deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders.
3. Dampen surfaces and apply new shotcrete. Match adjacent color and finish.

B. Repair core holes from in-place testing according to repair provisions in ACI 301 (ACI 301M), except do not use shotcrete. Match adjacent color and finish.

3.14 CLEANING

A. Immediately remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

END OF SECTION 033713

SECTION 033816 - UNBONDED POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Post-tensioning tendons and accessories, including pocket formers, bar chairs, slab bolsters, and nonprestressed reinforcement required for installing post-tensioning tendons.
2. Post-tensioning operations, including stressing, recording tendon elongations and gage pressures, and finishing tendons.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing tendon layout, installation procedures.

D. Delegated-Design Submittal: For post-tensioning system.

1. Include sealed design calculations prepared by a qualified structural engineer indicating method of elongation calculation, including values used for friction coefficients, anchorage seating loss, elastic shortening, creep, relaxation, and shrinkage.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer or testing agency as directed.

B. Evaluation Reports: For anchorage devices and couplers.

C. Product Certificates: For encapsulation systems.

D. Mill Test Reports: For prestressing strand.

E. Field quality-control reports.

F. Stressing Records: Submit the same day as stressing operations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."

B. Installer Qualifications: A qualified installer whose full-time Project superintendent has successfully completed PTI's Level 1 - Field Fundamentals course or has equivalent verifiable experience and knowledge acceptable to Architect.

1. Superintendent shall be trained by post-tensioning supplier in the operation of stressing equipment to be used on Project.

C. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

1. Testing Agency Inspector: Personnel performing field inspections and measuring elongations shall have successfully completed PTI's Level 1 - Field Fundamentals course or shall have equivalent verifiable experience and knowledge acceptable to Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle post-tensioning materials according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design post-tensioned reinforcement.

B. Design structure to withstand the loads indicated according to governing codes, within limits and under conditions indicated.

C. Average Precompression:

1. Minimum Average Slab Precompression: 125 psi (0.86 MPa) or 200 psi (1.4 MPa) as directed.
2. Maximum Average Slab Precompression: 300 psi (2.1 MPa) or 500 psi (3.4 MPa) as directed.
3. Minimum Average Precompression in T-, L-, and Rectangular-Beam Cross Sections: 200 psi (1.4 MPa).
4. Minimum Precompression in Slab Section Not Included in T- or L-Beam Section: 100 psi (0.7 MPa).
5. Maximum Precompression in Transfer Girders: 1000 psi (6.9 MPa). Specify stage-stressing sequence to avoid overstress.

D. Comply with ACI 318 (ACI 318M) requirements unless more stringent requirements are indicated.

E. Fire Resistance: Design members such that thickness and concrete cover over reinforcement comply with fire-resistance requirements of authorities having jurisdiction.

F. Fire Resistance: Design members such that thickness and concrete cover over reinforcement comply with the following fire-resistance requirements:

1. Slabs: Two hours.
2. Beam: Two hours.

G. Deflection Limits, Including Creep and Shrinkage Effects, as Follows:

1. Total Dead Load: L/600.
2. Total Dead Plus Live Load: L/360.

H. Closure Strips: Locate closure strips at midspan and adjust tendon forces and profiles accordingly. Calculate moments in spans with closure strips assuming a continuous slab. Provide only nonprestressed reinforcement within closure strips. Design reinforcement in closure strip to carry ultimate moment at midspan.

2.2 PRESTRESSING TENDONS

A. ACI Publications: Comply with ACI 423.7 unless otherwise indicated.

B. Prestressing Strand: ASTM A416/A416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation, 0.5-inch- (12.7-mm-) or 0.6-inch- (15.2-mm-) diameter strand as directed.

C. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties; chemically stable and nonreactive with prestressing strand, nonprestressed reinforcement, sheathing material, and concrete.

D. Tendon Sheathing:

1. Material: Polyethylene or polypropylene with a minimum density of 0.034 lb/cu. in. (0.9 g/cu. cm).
2. Minimum Thickness: 0.050 inch (1.25 mm).
3. Continuous over length of tendon to provide watertight encapsulation of prestressing strand and between anchorages to prevent intrusion of cement paste or loss of coating for a nonencapsulated system.

E. Anchorage and Coupler Assemblies: Assemblies of prestressing strand, wedges, and anchor or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.

F. Encapsulation System: Watertight encapsulation of prestressing strand consisting of the following:

1. Encapsulation Caps: Attached to anchorages with a positive mechanical connection and completely filled with post-tensioning coating.

2. Sleeves: Attached to anchorage with positive mechanical connection; overlapped a minimum of 4 inches (100 mm) with sheathing and completely filled with post-tensioning coating.

2.3 NONPRESTRESSED STEEL BARS

A. Support Bars, Reinforcing Bars, and Hairpins:

1. Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
2. Low-Alloy Steel: ASTM A706/A706M, deformed.

B. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons and tendon support bars in place. Manufacture bar supports, according to CRSI's "Manual of Standard Practice," from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Use all-plastic, CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports as directed.

2.4 ACCESSORIES

A. Pocket Formers: Capable of completely sealing wedge cavity; sized to provide the required cover over the anchorage and allow access for cutting strand tail.

B. Anchorage Fasteners: As directed Stainless, Galvanized or Uncoated-steel nails, wires, and screws used to attach anchorages to formwork.

C. Sheathing Repair Tape: Elastic, self-adhesive, moistureproof tape with minimum width of 2 inches (50 mm), in contrasting color to tendon sheathing; nonreactive with sheathing, coating, or prestressing steel.

2.5 PATCHING MATERIAL

A. One-component, polymer-modified, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead applications. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design formwork to support load redistribution that may occur during stressing operation. Ensure that formwork does not restrain elastic shortening, camber, or deflection resulting from application of prestressing force.

B. Do not remove forms supporting post-tensioned elements until tendons have been fully stressed and elongations have been approved by Architect.

C. Do not place concrete in supported floors until tendons on supporting floors have been stressed and elongations have been approved by Architect.

3.2 NONPRESTRESSED STEEL REINFORCEMENT PLACEMENT

A. Placement of nonprestressed steel reinforcement is specified in Section 033000 "Cast-in-Place Concrete." Coordinate placement of nonprestressed steel reinforcement with installation of post-tensioning tendons.

3.3 TENDON INSTALLATION

A. Install tendons according to installation drawings and procedures stated in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."

1. Tolerances: Comply with tolerances in ACI 423.7 for beams and slabs.

B. Tendon Supports: Provide continuous slab bolsters or bars supported on individual high chairs spaced at a maximum of 42 inches (1070 mm) o.c. to ensure tendons remain in their designated positions during construction operations and concrete placement.

1. Support tendons as required to provide profiles shown on installation drawings. Position supports at high and low points and at intervals not exceeding 48 inches (1220 mm). Ensure that tendon profiles between high and low points are smooth parabolic curves.
2. Attach tendons to supporting chairs and reinforcement without damaging tendon sheathing.
3. Support slab tendons independent of beam reinforcement.

C. Maintain tendon profile within maximum allowable deviations from design profile as follows:

1. 1/4 inch (6.3 mm) for member depth less than or equal to 8 inches (200 mm).
2. 3/8 inch (9.5 mm) for member depth greater than 8 inches (200 mm) and less than or equal to 24 inches (610 mm).
3. 1/2 inch (13 mm) for member depth greater than 24 inches (610 mm).

D. Maintain minimum radius of curvature of 480-strand diameters for lateral deviations to avoid openings, ducts, and embedded items. Maintain a minimum of 2 inches (50 mm) of separation between tendons at locations of curvature.

E. Limit tendon bundles to five tendons. Do not twist or entwine tendons within a bundle. Maintain a minimum distance of 12 inches (300 mm) between center of adjacent bundles.

F. If tendon locations conflict with nonprestressed reinforcement or embedded items, tendon placement governs. Obtain Architect's approval before relocating tendons or tendon anchorages that interfere with one another.

G. Deviations in horizontal spacing and location of slab tendons are permitted when required to avoid openings and inserts.

H. Installation of Anchorages:

1. Place anchorages at locations shown on approved installation drawings.
2. Do not switch fixed- and stressing-end anchorage locations.
3. Attach pocket formers, intermediate anchorages, and stressing-end anchorages securely to bulkhead forms. Install stressing-end and intermediate anchorages perpendicular to tendon axis.
4. Install tendons straight, without vertical or horizontal curvature, for a minimum of 12 inches (300 mm) behind stressing-end and intermediate anchorages.
5. Embed intermediate anchorage devices at construction joints in first concrete placed at joint.
6. Minimum splice length in reinforcing bars at anchorages is 24 inches (600 mm). Stagger splices a minimum of 60 inches (1500 mm).
7. Place fixed-end anchorages in formwork at locations shown on installation drawings. Support anchorages firmly to avoid movement during concrete placement.
8. Remove loose encapsulation caps on fixed-end anchorages, refill with post-tensioning coating, and re-attach encapsulation caps to achieve a watertight enclosure.

I. Maintain minimum concrete cover according to ACI 423.7.

J. Maintain minimum clearance of 6 inches (150 mm) between tendons and openings.

K. Prior to concrete placement, mark tendon locations on formwork with spray paint.

L. Do not install sleeves within 36 inches (914 mm) of anchorages after tendon layout has been inspected.

M. Do not install conduit, pipe, or embeds requiring movement of tendons after tendon layout has been inspected.

N. Do not use couplers unless location has been approved by Architect.

3.4 SHEATHING INSPECTION AND REPAIR

A. Inspect sheathing for damage after installing tendons. Repair damaged areas by restoring post-tensioning coating and repairing or replacing tendon sheathing.

1. Ensure that sheathing is watertight and there are no air voids.
2. Follow tape repair procedures in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."

B. Maximum length of exposed strand behind anchorages is as follows:

1. Fixed End: 12 inches (300 mm).
2. Intermediate and Stressing End: 1 inch (25 mm).

    a. Cover exposed strand with sheathing repair tape to prevent contact with concrete.

C. Immediately remove and replace tendons that have damaged strand.

3.5 CONCRETE PLACEMENT

A. Ensure compaction of concrete around anchorages.

B. Ensure that position of tendons and nonprestressed-steel reinforcement do not change during concrete placement. Reposition tendons and nonprestressed-steel reinforcement moved during concrete placement to original location.

C. Ensure that method of concrete placement does not damage tendon sheathing. Do not support pump lines, chutes, or other concrete-placing equipment on tendons.

3.6 TENDON STRESSING

A. Calibrate stressing jacks and gages at start of project and at least every six months thereafter. Keep copies of calibration certificates for each jack-and-gage pair on Project site that are available for inspection. Exercise care in handling stressing equipment to ensure that proper calibration is maintained.

B. Stress tendons only under supervision of a qualified post-tensioning superintendent.

C. Do not begin stressing operations until concrete compressive strength has reached 3000 psi (20.7 MPa) as indicated by tests of field-cured cylinders.

D. Complete stressing within 96 hours of concrete placement.

E. If concrete has not reached required compressive strength, obtain Architect's approval to partially stress tendons and delay final stressing until concrete has reached required strength.

F. Stage stress transfer girders or foundation mats according to schedule shown on the Contract Drawings as directed.

G. If detensioning and restressing of tendon is required, discard wedges used in original stressing and provide new wedges.

H. Mark and measure elongations according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons." Measure elongations to closest 1/8 inch (3.2 mm).

I. Submit stressing records within one day of completion of stressing. If discrepancies between measured and calculated elongations exceed plus or minus 7 percent, resolve these discrepancies to satisfaction of Architect.

J. Prestressing will be considered acceptable if gage pressures shown on stressing record correspond to required stressing force and calculated and measured elongations agree within 7 percent.

K. If measured elongations deviate from calculated elongations by more than 7 percent, perform additional testing, restressing, strengthening, or replacing of affected elements unless otherwise approved by Architect.

3.7 TENDON FINISHING

A. Do not cut strand tails or cover anchorages until stressing records have been reviewed and approved by Architect.

B. Cut strand tails as soon as possible after approval of elongations.

C. Install encapsulation caps and sleeves on intermediate anchorages within one day of stressing.

D. Cut strand tails and install encapsulation caps on stressing-end anchorages within one day of Architect's acceptance of elongations.

E. Patch stressing pockets within one day of cutting strand tail. Clean inside surface of stressing pocket to remove laitance or post-tensioning coating before installing patching material. Finish patching material flush with adjacent concrete.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

1. Before concrete placement, as directed special inspector or testing agency will inspect the following for compliance with post-tensioning installation drawings and the Contract Documents:

    a. Location and number of tendons.
    b. Tendon profiles and cover.
    c. Installation of backup bars, hairpins, and other nonprestressed reinforcement shown on post-tensioning installation drawings.
    d. Installation of pocket formers and anchorage devices.
    e. Repair of damaged sheathing.
    f. Connections between sheathing and anchorage devices.

2. As directed Special inspector or Testing agency will record tendon elongations during stressing.
3. As directed Special inspector or Testing agency will immediately report deviations from the Contract Documents to Architect.

3.9 PROTECTION

A. Do not expose tendons to electric ground currents, welding sparks, or temperatures that would degrade components.

B. Protect exposed components within one workday of their exposure during installation.

C. Prevent water from entering tendons during installation and stressing.

D. Provide weather protection to stressing-end anchorages if strand tails are not cut within 10 days of stressing the tendons.

3.10 REPAIRS

A. Submit repair procedure to Architect for evaluation and approval.

B. Do not proceed with repairs requiring removal of concrete unless authorized in writing by Architect.

END OF SECTION 033816

SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes precast structural concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Design Mixtures: For each precast concrete mixture.

D. Shop Drawings:

1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.

E. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed For Installer, fabricator or testing agency.

B. Welding certificates.

C. Material certificates.

D. Material Test Reports: For aggregates.

E. Source quality-control reports.

F. Field quality-control and special inspection reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant as follows:

a. Group C, Category C1 - Precast Concrete Products (no prestressed reinforcement), Category C2 - Prestressed Hollowcore and Repetitively Produced Products, Category C3 - Prestressed Straight Strand Structural Members or Category C4 - Prestressed Deflected Strand Structural Members as directed.

B. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.6 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast structural concrete units.

B. Design Standards: Comply with ACI 318 (ACI 318M) and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

C. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.

1. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 (Grade 420) or ASTM A706/A706M, deformed bars, assembled with clips as directed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, as directed fabricated from as-drawn steel or galvanized-steel wire into flat sheets.

E. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M or ASTM A1064/A1064M, flat sheet.

F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.3 PRESTRESSING TENDONS

A. Strand: ASTM A416/A416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation strand.

1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
5. Blended Hydraulic Cement: As directed.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with Class 5S, Class 5M, Class 4S or Class 4M as directed. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

E. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable-Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30 (Grade 415-205).

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).

I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.

J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563 (ASTM A563M); and flat, unhardened steel washers, ASTM F844.

K. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: As directed.

L. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

M. Zinc-Coated Finish: For exterior steel items steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M electrodeposition according to ASTM B633, SC 3, Types 1 and 2 as directed.

1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

N. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 or SSPC-Paint 25 according to SSPC-PA 1 as directed.

2.6 BEARING PADS

A. Provide bearing pads for precast structural concrete units as recommended by precast fabricator for application.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.8 INSULATED FLAT-WALL PANEL ACCESSORIES

A. Molded-Polystyrene Board Insulation: As directed.

B. Extruded-Polystyrene Board Insulation: As directed.

C. Polyisocyanurate Board Insulation: As directed.

D. Wythe Connectors: As directed.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
2. As directed Limit use of fly ash to 20 or 35 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 or 50 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested according to ASTM C1218/C1218M.

D. Normal-Weight Concrete Mixtures: As directed Proportion face and backup mixtures, full-depth mixture or face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: Limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

K. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

L. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.11 CASTING INSULATED WALL PANELS

A. Cast, screed, and consolidate wythe supported by mold.

B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.

C. Cast, screed, and consolidate top wythe to meet required finish.

2.12 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.13 COMMERCIAL FINISHES

A. Commercial Grade: Remove fins and protrusions larger than 1/8 inch (3 mm) and fill holes larger than 1/2 inch (13 mm). Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch (5 mm).

B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch (13 mm) caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch (6 mm) in width that occur more than once per 2 sq. in. (1300 sq. mm). Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch (3 mm).

C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch (6 mm) in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch (3 mm) in width that occur more than once per 2 sq. in. (1300 sq. mm). Grind smooth form offsets or fins larger than 1/8 inch (3 mm). Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.

D. Grade A Finish: Repair surface blemishes and fill air holes with the exception of air holes 1/16 inch (1.6 mm) in width or smaller, and form marks where the surface deviation is less than 1/16 inch (1.6 mm). Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.

E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

G. Apply roughened surface finish according to ACI 318 (ACI 318M) to precast concrete units that receive concrete topping after installation.

2.14 SOURCE QUALITY CONTROL

A. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712/C1712M.

B. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
2. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
3. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.

C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Field cutting of precast units is not permitted without approval of Architect.

E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

3.2 ERECTION TOLERANCES

A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: As directed Owner will engage or Engage a qualified special inspector to perform the following special inspections:

1. Erection of precast structural concrete members.
2. Special inspections as directed.

B. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.4 REPAIRS

A. Repair precast structural concrete units if permitted by Architect.

1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.5 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes architectural precast concrete cladding and load-bearing units.

1.2 DEFINITIONS

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

D. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate details at building corners.

E. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

F. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Material certificates.

C. Material Test Reports: For aggregates.

D. Field quality-control and special inspection reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units at time of bidding or designated as an APA-certified plant for production of architectural precast concrete products.

B. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

D. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of two sample panels approximately 16 sq. ft. (1.5 sq. m) in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

1.7 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design architectural precast concrete units.

B. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

C. Calculated Fire-Test-Response Characteristics: As directed Provide architectural precast concrete units with fire-resistance rating indicated as calculated according to ACI 216.1 (ACI 216.1M) or PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and acceptable to authorities having jurisdiction.

D. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding design loads indicated within limits and under conditions indicated.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from as-drawn or galvanized-steel wire into flat sheets as directed.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M, flat sheet.

E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.3 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A416/A416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation strand.

1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C595, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan, Type I (PM), pozzolan-modified Portland or Type I (SM), slag-modified portland cement as directed.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: Uniformly graded, Gap graded or To match design reference sample as directed.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30 (Grade 415-205).

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).

I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.

J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A or ASTM F1554, Grade 36 (ASTM F568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563 (ASTM A563M); and flat, unhardened steel washers, ASTM F844.

K. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

L. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M or electrodeposition according to ASTM B633, SC 3, Types 1 and 2 as directed.

1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 or SSPC-Paint 25 according to SSPC-PA 1 as directed.

2.6 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C1218/C1218M.

E. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.8 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

F. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.9 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2.10 FINISHES

A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample, sample panels or mockups as directed and as follows:

1. Design Reference Sample: As directed.

2. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
3. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
4. Textured-Surface Finish: Impart by form liners or inserts.
5. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
6. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
7. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
8. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
9. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
11. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.

B. Finish exposed top or back surfaces of architectural precast concrete units to match face-surface finish as directed.

C. Finish exposed top or back surfaces of architectural precast concrete units with smooth, steel-trowel finish as directed.

D. Finish unexposed surfaces of architectural precast concrete units with as cast finish.

2.11 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
2. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.2 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: As directed Owner will engage or Engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Erection of loadbearing precast concrete members.
2. Special inspections as directed.

B. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.4 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 034713 - TILT-UP CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes load-bearing, tilt-up concrete, monolithic panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Design Mixtures: For each concrete mixture.

D. Shop Drawings: Detail fabrication and installation of tilt-up concrete units. Indicate panel locations, plans, elevations, dimensions, shapes, cross sections, and details of steel embedments. Match panel identification designations on Shop Drawings with those on Contract Drawings.

1. Include steel reinforcement, detailing fabrication, bending, and placing.
2. Include additional steel reinforcement to resist hoisting and erection stresses.
3. Include locations and details of hoisting points and lifting devices for handling and erection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed.

B. Welding certificates.

C. Material certificates.

D. Material test reports.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: A qualified installer who employs a supervisor on Project who is an ACI-certified Tilt-up Supervisor.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.4/D1.4M.

E. Mockups: Cast and erect tilt-up concrete panel mockups to demonstrate typical reveals, surface finishes, texture, color, and standard of workmanship.

1. Build mockup panels in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete mixtures.

PART 2 - PRODUCTS

2.1 TILT-UP CONCRETE

A. Comply with ACI 301 (ACI 301M), unless modified by requirements in the Contract Documents.

2.2 FORMS AND ACCESSORIES

A. Forms: Metal, dressed lumber, or other approved materials that are nonreactive with concrete and that will provide continuous, true, and smooth concrete surfaces.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm).

C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

D. Reveal Strips: Metal, PVC, rubber, straight dressed wood, or plywood; with sides kerfed.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Wire: ASTM A82/A82M, as drawn or galvanized as directed.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A185/A185M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A497/A497M, flat sheet.

F. Bar Supports: Manufactured according to CRSI's "Manual of Standard Practice" of plastic or CRSI Class 1 plastic-protected steel wire or Class 2 stainless-steel wire.

2.4 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C150/C150M, class as directed.
2. Fly Ash: ASTM C618, Class F or Class C as directed.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595/C595M, class as directed.

B. Coarse Aggregate: ASTM C33/C33M, Class 4S, Class 4M or Class 1N coarse aggregate as directed or better, graded. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: As directed 1 inch (25 mm) or 3/4 inch (19 mm) nominal.

C. Fine Aggregate: ASTM C33/C33M or ASTM C144, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water: ASTM C94/C94M and potable.

2.5 BOND BREAKERS

A. Solvent-Borne, Chemically Reactive Bond Breaker: Penetrating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

B. Solvent-Borne, Membrane-Forming Bond Breaker: Dissipating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

C. Waterborne, Chemically Reactive Bond Breaker: Penetrating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

D. Waterborne, Membrane-Forming Bond Breaker: Dissipating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.

2.7 CONNECTION MATERIALS

A. Embedded Metal Items and Loose Hardware: Comply with Section 055000 "Metal Fabrications" for materials for securing tilt-up concrete panels together and to supporting and adjacent construction.

B. Loose Hardware: Comply with Section 055000 "Metal Fabrications" for materials for securing tilt-up concrete panels together and to supporting and adjacent construction.

C. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

D. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

E. Unheaded Carbon-Steel Rods and Nuts: ASTM A36/A36M, threaded rods with ASTM A563, nuts.

F. Welded Headed Studs: AWS D1.1/D1.1M, Type B headed studs, and cold-finished, carbon-steel bars.

G. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

H. Chord Bar Sleeves: Tubular sheathing, plastic or moisture-resistance-treated cardboard.

I. Welding Electrodes: Comply with AWS standards.

J. Hot-Dip Galvanized Finish: Apply zinc coating to steel connections by hot-dip process, complying with ASTM A123/A123M or ASTM A153/A153M as applicable.

1. Zinc Repair Paint: SSPC-Paint 20.

K. Shop-Primed Finish: Prepare surfaces of steel connections, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop-apply primer according to SSPC-PA 1.

1. Primer: As directed MPI#79 or MPI#76.

2.8 LIFTING INSERTS AND ACCESSORIES

A. Furnish inserts, dowels, bolts, nuts, washers, and other items to be cast in panels for tilting and lifting.

1. Manufacture inserts with feet of plastic, galvanized-steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.

B. Furnish brace anchors and other accessories to be cast in panels and in casting slab for attaching bracing.

1. Manufacture wall brace anchors and accessories with feet of galvanized-steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.
2. Manufacture floor brace anchors that do not penetrate vapor retarder under slab-on-grade.

2.9 BEARING PADS

A. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet; Type A Shore durometer hardness of 50 to 70, ASTM D2240; and minimum tensile strength of 2250 psi (15.5 MPa), ASTM D412.

B. Random, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer with a Type A Shore durometer hardness of 70 to 90, ASTM D2240.

C. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded in elastomer with a Type A Shore durometer hardness of 80 to 100, ASTM D2240.

D. High-Density Plastic Strips: Multimonomer, nonleaching plastic.

2.10 GROUT

A. Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents; complying with ASTM C1107, of consistency suitable for application.

2.11 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures based on laboratory trial mixtures.

B. Proportion concrete mixture as follows:

1. Minimum Compressive Strength: As directed.
2. Maximum W/C Ratio: As directed.
3. Slump Limit: As directed 4 inches (100 mm), 5 inches (125 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range, water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-inch (38-mm) nominal maximum aggregate size at point of delivery.
5. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) or 3/4-inch (19-mm) nominal maximum aggregate size at point of delivery as directed.
6. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete according to ACI 301 (ACI 301M) requirements.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Construct and brace formwork so tilt-up concrete panels are of size, shape, alignment, elevation, and position indicated.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.

3.2 BOND BREAKER INSTALLATION

A. Uniformly and continuously apply two coats of bond breaker to casting-slab surfaces by power spray or roller according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.

B. After placing steel reinforcement, touch up or recoat worn or damaged areas with bond breaker. Do not splash or coat steel reinforcement and inserts.

3.3 REINFORCEMENT AND INSERT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating and placing reinforcement.

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

C. Accurately place and securely support embedded items, anchorages, inserts, cramps, retainers, bar chords and sleeves, and other items to be built into panels. Coordinate with other trades for installing cast-in items.

3.4 PANEL CASTING, GENERAL

A. Comply with ACI 301 (ACI 301M) for handling, placing, and consolidating concrete.

B. Screed panel surfaces to correct level with a straightedge and strike off.

1. Begin initial floating before excess moisture or bleedwater appears on the surface. Use bull floats or darbies to form a uniform and open-textured surface plane free of humps or hollows. Do not disturb panel surfaces before beginning finishing operations.

C. Form chamfers at top edges of panel perimeters, openings, and similar locations not formed by chamfer strips unless otherwise indicated.

D. Surface Defects: Limit visible surface defects to those permitted by TCA's "Tilt-up Concrete Association's Guideline Specifications" for Grade A, Architectural, Grade B, Standard or Grade C, Utility panel surfaces as directed.

3.5 CASTING TOLERANCES

A. Cast tilt-up concrete panels without exceeding the tolerances of TCA's "Tilt-up Concrete Association's Guideline Specifications."

3.6 FACE-UP FINISHES

A. Float Finish: Consolidate surface of plastic concrete with power-driven floats or by hand floating. Restraighten and cut down high spots and fill low spots. Repeat float passes and restraighten until surface is left with a uniform, smooth, granular texture.

B. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.

C. Trowel and Fine-Broom Finish: After applying float finish, apply a partial trowel finish to plastic concrete, stopping after second troweling. Immediately after second troweling, and when concrete is still plastic, slightly scarify the surface with a fine broom.

1. Broom surface in a top-to-bottom or side-to-side direction as directed.

3.7 FACE-DOWN FINISHES

A. Smooth, As-Cast Finish: Cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

B. Form-Liner Finish: Cast panel over form liners placed, secured, and sealed over casting slab to produce a textured surface free of pockets, streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

3.8 CONCRETE PROTECTING AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301 (ACI 301M).

1. Apply evaporation retarder in hot, dry, or windy weather to protect concrete from rapid moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after screeding and bull floating concrete, but before float finishing.

B. Begin curing immediately after finishing concrete. Cure by one or a combination of the following methods according to ACI 308.1:

1. Moisture Curing: Keep surfaces continuously moist for no fewer than seven days.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover. Cure for no fewer than seven days.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.

3.9 ERECTION

A. Use erection equipment with care to prevent damage to floor slabs and panels.

B. Lift, support, and erect panels only at designated lifting or supporting points indicated on Shop Drawings.

C. Do not erect panels until 75 percent of 28-day compressive strength of concrete has been verified.

D. Install tilt-up concrete panels level, plumb, square, and true. Place panels on leveled grout-setting pads or shims in correct position. Maintain joint width of 1/2 inch (13 mm) or 3/4 inch (19 mm) between panels as directed.

1. Install tilt-up concrete panels with face-down surfaces exposed to exterior of building.

E. Temporarily brace and support panels securely in position against loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to panels are secured.

F. Anchor panels in place and, if indicated, to one another.

1. Weld steel connectors to steel supports and embedments indicated, complying with AWS D1.1/D1.1M.

G. Solidly grout-fill gaps between foundation system and bottom of panels.

3.10 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before erection of tilt-up panels.

D. Testing Services: Tests shall be performed according to ACI 301 (ACI 301M).

E. Tilt-up concrete panels will be considered defective if they do not pass tests and inspections.

3.11 ERECTION TOLERANCES

A. Install tilt-up concrete panels without exceeding the erection tolerances in TCA's "Tilt-up Concrete Association's Guideline Specifications."

3.12 FILLING AND REPAIR

A. Patch holes and voids left by erecting and bracing inserts on tilt-up panels and slabs-on-grade. Cut or chip edges of voids perpendicular to concrete surface. Fill blockouts where indicated.

1. Clean, dampen with water, and brush-coat holes, voids, and blockouts with bonding agent. Fill and compact with patching mortar of a stiff consistency before bonding agent has dried.

B. Repair damaged galvanized-steel surfaces of connectors by cleaning and applying a coat of zinc repair paint.

C. Repair damage to tilt-up panels and slabs-on-grade resulting from tilt-up work, as directed by Architect.

D. Remove and replace tilt-up panels that do not comply with requirements in this Section.

END OF SECTION 034713

SECTION 034900 - GLASS-FIBER-REINFORCED CONCRETE (GFRC)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glass-fiber-reinforced concrete (GFRC) panels consisting of GFRC, panel frames, anchors, and connection hardware.

1. GFRC panels include as directed.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for embedding weld plates and angles in concrete for attaching connection devices.
2. Section 051200 "Structural Steel Framing" for attaching connection devices to steel framing.
3. Section 079200 "Joint Sealants" for elastomeric joint sealants and sealant backings.

1.3 DEFINITIONS

A. Design Reference Sample: Sample of GFRC color, finish, and texture that has been preapproved by Architect before execution of the Contract.

1. Design Reference Sample: as directed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include GFRC design mixes.

B. Shop Drawings: Show fabrication and installation details for GFRC panels including the following:

1. Panel elevations, sections, and dimensions.
2. Thickness of facing mix, GFRC backing, and bonding pads for typical panels.
3. Finishes.

4. Joint and connection details.
5. Erection details.
6. Panel frame details for typical panels including sizes, spacings, thicknesses, and yield strengths of various members.
7. Locations and details of connection hardware attached to structure.
8. Sizes, locations, and details of flex, gravity, and seismic anchors for typical panels.
9. Other items sprayed into panels.
10. Erection sequence for special conditions.
11. Relationship to adjacent materials.
12. Description of loose, cast-in, and field hardware.

C. Samples for Verification: For each type of finish indicated on exposed GFRC surfaces, representative of finish, color, and texture variations expected, approximately 12 by 12 inches (305 by 305 mm) by actual thickness.

D. Delegated-Design Submittal: For GFRC panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Steel Sheet Certificates: For steel sheet used in cold-formed steel panel framing, mill certificates signed by manufacturers of steel sheet, or test reports from a qualified testing agency, indicating that steel sheet used in cold-formed metal panel framing complies with requirements including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.

D. Mill Certificates: For structural-steel shapes and hollow structural sections used in panel framing.

E. Source Quality-Control Program: For GFRC manufacturer.

F. Source Quality-Control Test Reports: For GFRC, inserts, and anchors.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Designated a PCI-certified plant for Group G - Glass Fiber Reinforced Concrete or designated an APA-certified plant for GFRC production.

B. Installer Qualifications: Manufacturer of GFRC panels.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," and AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.

    a. Include typical components, attachments to building structure, and methods of installation.
    b. Include window opening with GFRC returns.
    c. Include sealant-filled joint complying with requirements in Section 079200 "Joint Sealants."

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and transport GFRC panels supported on nonstaining material and with nonstaining resilient spacers between panels.

B. Store GFRC panels off of ground on firm, level, and smooth surfaces supported on nonstaining material and with nonstaining resilient spacers between panels. Place stored panels so identification marks are clearly visible.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, as directed:

B. Source Limitations: Obtain GFRC panels from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design GFRC panels, including panel frames, anchors, and connections.

B. Structural Performance: GFRC panels, including panel frames, anchors, and connections, shall withstand the following design loads as well as the effects of thermal- and moisture-induced dimensional changes within limits and under conditions indicated:

1. Loads: As indicated.
2. Dead Loads: As directed.
3. Live Loads: As directed.
4. Wind Loads: As directed
5. Seismic Loads: As directed
6. Project-Specific Loads: As directed.
7. Deflection Limits: Design panel frames to withstand design loads without lateral deflections greater than 1/240 of wall span.

8. Thermal Movements: Provide for thermal movements resulting from annual ambient temperature changes of 80 deg F (26 deg C) or 120 deg F (67 deg C) Design panel frames and connections to accommodate deflections and other building movements.
9. Design panel frames to transfer window loads to building structure.

C. PCI Manuals: Comply with requirements and recommendations in the following PCI manuals unless more stringent requirements are indicated:

1. PCI MNL 128, "Recommended Practice for Glass Fiber Reinforced Concrete Panels."
2. PCI MNL 130, "Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products."

D. AISI Specifications: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

E. AISC Specifications: Comply with AISC 360, "Specification for Structural Steel Buildings."

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous GFRC surfaces within tolerances; nonreactive with GFRC and capable of producing required finish surfaces.

1. Mold-Release Agent: Commercially produced liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated to match GFRC design reference sample. Provide solid backing and form supports to ensure that form liners remain in place during GFRC application. Use with manufacturer's recommended liquid-release agent that does not bond with, stain, or adversely affect GFRC surfaces and does not impair subsequent surface or joint treatments of GFRC.

C. Surface Retarder: Chemical liquid-set retarder capable of temporarily delaying hardening of newly placed GFRC face mix to depth of reveal specified.

2.4 GFRC MATERIALS

A. Portland Cement: ASTM C150/C150M; Type I, II, or III.

1. For surfaces exposed to view in finished structure, use gray or white of same type, brand, and source throughout GFRC production.

B. Metakaolin: ASTM C618, Class N.

C. Glass Fibers: Alkali resistant, with a minimum zirconia content of 16 percent, 1 to 2 inches (25 to 50 mm) long, specifically produced for use in GFRC, and complying with ASTM C1666/C1666M.

D. Sand: Washed and dried silica, complying with composition requirements in ASTM C144; passing a No. 20 (0.85-mm) sieve with a maximum of 2 percent passing a No. 100 (0.15-mm) sieve.

E. Facing Aggregate: ASTM C33/C33M, except for gradation, and PCI MNL 130, 1/4-inch (6-mm) maximum size.

1. Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match sample.
2. Fine Aggregate: Natural or manufactured sand with a maximum of 5 percent passing a No. 100 (0.15-mm) sieve and a maximum of 3 percent passing a No. 200 (0.075-mm) sieve.

F. Coloring Admixture: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures, temperature stable, nonfading, and alkali resistant.

G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of GFRC and complying with chemical limits in PCI MNL 130.

H. Polymer-Curing Admixture: Acrylic thermoplastic copolymer dispersion complying with PCI MNL 130.

I. Air-Entraining Admixture: ASTM C260/C260M, containing not more than 0.1 percent chloride ions.

J. Chemical Admixtures: ASTM C494/C494M, containing not more than 0.1 percent chloride ions.

2.5 ANCHORS, CONNECTORS, AND MISCELLANEOUS MATERIALS

A. Stainless-Steel Plates: ASTM A240/A240M or ASTM A666, Type 304.

B. Carbon-Steel Shapes and Plates: ASTM A36/A36M, finished as follows:

1. Finish: Zinc coated by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable or electrodeposition according to ASTM B633, SC 3, or as directed.
2. Finish: Shop primed with paint complying with MPI#79 on surfaces prepared to comply with SSPC-SP 2, "Hand Tool Cleaning," or better.

C. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.

D. Carbon-Steel Bars: ASTM A108, Grade 1018, not less than 1/4 inch (6 mm) in diameter, finished as follows:

1. Finish: Zinc coated by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable, electrodeposition according to ASTM B633, SC 3 or as directed..
2. Finish: Shop primed with paint complying with MPI#79 on surfaces prepared to comply with SSPC-SP 2, "Hand Tool Cleaning," or better.

E. Malleable-Iron Castings: ASTM A47/A47M, Grade 32510 (Grade 22010).

F. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30 (Grade 415-205).

G. Bolts: ASTM A307 (ASTM F568M) or ASTM F3125/F3125M, Grade A325 (Grade A325M) finished as follows:

1. Finish: Zinc coated by hot-dip process according to ASTM A123/A123M, after fabrication, and ASTM A153/A153M, as applicable, electrodeposition according to ASTM B633, SC 3, or as directed.

H. Reglets: PVC extrusions, Stainless steel, ASTM A240/A240M, Type 304, 0.016 inch (0.40 mm) thick or as directed.

2.6 PANEL FRAME MATERIALS

A. Cold-Formed Steel Framing: Manufacturer's standard C-shaped steel studs, complying with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members," with minimum uncoated steel thickness of 0.053 inch (1.35 mm) of web depth indicated; with stiffened flanges, U-shaped steel track; and of the following steel sheet:

1. Metallic-Coated Steel Sheet: ASTM A653/A653M, structural-steel sheet, G60 (Z180) G90 (Z275) zinc coating, of grade required by structural performance of framing.
2. Painted, Nonmetallic-Coated Steel Sheet: ASTM A1011/A1011M, hot rolled; or ASTM A1008/A1008M, cold rolled; nonmetallic coated according to ASTM A1003/A1003M; of grade required by structural performance of framing.

B. Hollow Structural Sections: Steel tubing, ASTM A500/A500M, Grade B, or ASTM A513, finished as follows:

1. Finish: Shop primed with organic zinc-rich primer complying with SSPC-Paint 20 on surfaces prepared to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Finish: Shop primed with paint complying with MPI#79 on surfaces prepared to comply with SSPC-SP 2, "Hand Tool Cleaning," or better.

C. Steel Channels and Angles: ASTM A36/A36M, finished as follows:

1. Finish: Shop primed with organic zinc-rich primer complying with SSPC-Paint 20 on surfaces prepared to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Finish: Shop primed with paint complying with MPI#79 on surfaces prepared to comply with SSPC-SP 2, "Hand Tool Cleaning," or better.

2.7 GFRC MIXES

A. Mist Coat: Portland cement, sand slurry, and admixtures; of same proportions as backing mix without glass fibers.

B. Face Mix: Proportion face mix of portland cement, sand, facing aggregates, and admixtures to comply with design requirements.

C. Backing Mix: Proportion backing mix of portland cement, glass fibers, sand, and admixtures to comply with design requirements. Provide nominal glass-fiber content of not less than 5 percent by weight of total mix.

D. Polymer-Curing Admixture: 6 to 7 percent by weight of polymer-curing admixture solids to dry portland cement.

E. Air Content: 8 to 10 percent; ASTM C185.

F. Coloring Admixture: Not to exceed 10 percent of cement weight.

2.8 PANEL FRAME FABRICATION

A. Fabricate panel frames and accessories plumb, square, true to line, and with components securely fastened.

1. Fabricate panel frames using jigs or templates.
2. Cut cold-formed metal framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding. Comply with AWS D1.3/D1.3M.
4. Fasten framing members of hollow structural sections, steel channels, or steel angles by welding. Comply with AWS D1.1/D1.1M.
5. Weld anchors to panel frames.

B. Reinforce framing assemblies, as necessary, to withstand erection stresses.

C. Galvanizing Repair: Touch up damaged galvanized surfaces according to ASTM A780/A780M.

D. Painting Repair: Touch up damaged painted surfaces using same primer.

2.9 MOLD FABRICATION

A. Construct molds that result in finished GFRC complying with profiles, dimensions, and tolerances indicated, without damaging GFRC during stripping. Construct molds to prevent water leakage and loss of cement paste.

1. Coat contact surfaces of molds with form-release agent.
2. Coat contact surfaces of molds with surface retarder.

B. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during GFRC application. Coat form liner with form-release agent.

C. Locate, place, and secure flashing reglets accurately.

2.10 GFRC FABRICATION

A. Proportioning and Mixing: For backing mix, meter sand/cement slurry and glass fibers to spray head at rates to achieve design mix proportions and glass-fiber content according to PCI MNL 130 procedures.

B. Spray Application: Comply with general procedures as follows:

1. Spray mist coat over molds to a nominal thickness of 1/8 inch (3 mm) on planar surfaces.
2. Spray or place face mix in thickness indicated on Shop Drawings.
3. Proceed with spraying backing mix before face mix and/or as directed mist coat has set, using procedures that produce a uniform thickness and even distribution of glass fibers and matrix.
4. Consolidate backing mix by rolling or other technique to achieve complete encapsulation of glass fibers and compaction.
5. Measure thickness with a pin gage or other acceptable method at least once for every 5 sq. ft. (0.5 sq. m) of panel surface. Take no fewer than six measurements per panel.

C. Hand form and consolidate intricate details, incorporate formers or infill materials, and overspray before material reaches initial set to ensure complete bonding.

D. Attach panel frame to GFRC before initial set of GFRC backing, maintaining a minimum clearance of 1/2 inch (13 mm) from GFRC backing, and without anchors protruding into GFRC backing.

E. Build up homogeneous GFRC bonding pads over anchor feet, maintaining a minimum thickness of 1/2 inch (13 mm) over tops of anchor feet, before initial set of GFRC backing. Measure bonding pad thickness at 25 percent of anchor locations.

F. Inserts and Embedments: Build up homogeneous GFRC bosses or bonding pads over inserts and embedments to provide enough anchorage and embedment to comply with design requirements.

G. Curing: Employ initial curing method that ensures sufficient strength for removing units from mold. Comply with PCI MNL 130 procedures.

1. Keep moisture off of the surfaces of mixes with polymer curing admixtures during the first three hours of curing. Maintain temperature between 60 and 120 deg F (16 and 49 deg C) during the first 16 hours.
2. Prevent drying of moist curing mixes during the first 24 hours. Maintain units in surface-damp condition at a temperature above 60 deg F (16 deg C) and 95 percent relative humidity for seven days.

H. Panel Identification: Mark each GFRC panel to correspond with identification mark on Shop Drawings. Mark each panel with its casting date.

2.11 FABRICATION TOLERANCES

A. Manufacturing Tolerances: Manufacture GFRC panels so each finished unit complies with PCI MNL 130 for dimension, position, and tolerances.

B. Manufacturing Tolerances: Manufacture GFRC panels so each finished unit complies with the following dimensional tolerances. For dimensional tolerances not listed below, comply with PCI MNL 130.

1. Overall Height and Width of Units, Measured at the Face Adjacent to Mold: As follows:

   a. 10 feet (3 m) or less, plus or minus 1/8 inch (3 mm).
   b. More than 10 feet (3 m), plus or minus 1/8 inch per 10 feet (3 mm per 3 m); 1/4 inch (6 mm) maximum.

2. Edge Return Thickness: Plus 1/2 inch (13 mm), minus zero inch (zero mm).
3. Architectural Facing Thickness: Plus 1/8 inch (3 mm), minus zero inch (zero mm).
4. Backing Thickness: Plus 1/4 inch (6 mm), minus zero inch (zero mm).
5. Panel Depth from Face of Skin to Back of Panel Frame or Integral Rib: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
6. Angular Variation of Plane of Side Mold: Plus or minus 1/32 inch per 3 inches (0.8 mm per 75 mm) of depth, or plus or minus 1/16 inch (1.5 mm) total, whichever is greater.
7. Variation from Square or Designated Skew (Difference in Length of Two Diagonal Measurements): Plus or minus 1/8 inch per 72 inches (3 mm per 1800 mm) or plus or minus 1/4 inch (6 mm) total, whichever is greater.
8. Local Smoothness: 1/4 inch per 10 feet (6 mm per 3 m).
9. Bowing: Not to exceed L/240 unless unit complies with erection tolerances using connection adjustments.
10. Length and Width of Block Outs and Openings within One Unit: Plus or minus 1/4 inch (6 mm).
11. Location of Window Opening within Panel: Plus or minus 1/4 inch (6 mm).
12. Maximum Permissible Warpage of One Corner out of the Plane of the Other Three: 1/16 inch per 12 inches (1.5 mm per 305 mm) of distance from nearest adjacent corner.

C. Position Tolerances: Measured from datum line locations, as indicated on Shop Drawings.

1. Panel Frame and Track: Plus or minus 1/4 inch (6 mm).
2. Flashing Reglets at Edge of Panel: Plus or minus 1/4 inch (6 mm).
3. Inserts: Plus or minus 1/2 inch (13 mm).
4. Special Handling Devices: Plus or minus 3 inches (75 mm).
5. Location of Bearing Devices: Plus or minus 1/4 inch (6 mm).
6. Blockouts: Plus or minus 3/8 inch (10 mm).

D. Panel Frame Tolerances: As follows:

1. Vertical and Horizontal Alignment: 1/4 inch per 10 feet (6 mm per 3 m).
2. Spacing of Framing Member: Plus or minus 3/8 inch (10 mm).
3. Squareness of Frame: Difference in length of diagonals of 3/8 inch (10 mm).
4. Overall Size of Frame: Plus or minus 3/8 inch (10 mm).

2.12 FINISHES

A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints, shall be uniform, straight, and sharp. Finish exposed-face surfaces of GFRC to match approved design reference sample and mockups, as directed and as follows:

1. As-Cast-Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb, with uniform color and texture.
2. Textured-Surface Finish: Impart by form liners.
3. Retarded Finish: Use chemical-retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
4. Sand- or Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
5. Acid-Etched Finish: Use acid and hot-water solution equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.

2.13 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Establish and maintain a quality-control program for manufacturing GFRC panels according to PCI MNL 130.

1. Test materials and inspect production techniques.
2. Quality-control program shall monitor glass-fiber content, spray rate, unit weight, product physical properties, anchor pull-off and shear strength, and curing period and conditions.
3. Prepare test specimens and test according to ASTM C1228, PCI MNL 130, and PCI MNL 128 procedures.
4. Test GFRC inserts and anchors according to ASTM C1230 to validate design values.
5. Produce test boards at a rate of no fewer than one per work shift per operator for each spray machine and for each mix design.

    a. For each test board, determine glass-fiber content according to ASTM C1229 and flexural yield and ultimate strength according to ASTM C947.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structure and conditions for compliance with requirements for installation tolerances, bearing surfaces, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Install clips, hangers, and other accessories required for connecting GFRC panels to supporting members and backup materials.

B. Install GFRC panels level, plumb, square, and in alignment. Provide temporary supports and bracing as required to maintain position, stability, and alignment of panels until permanent connections are completed.

1. Maintain horizontal and vertical joint alignment and uniform joint width.
2. Remove projecting hoisting devices.

C. Connect GFRC panels in position by bolting or welding, or both, as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as possible after connecting is completed.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.3/D1.3M requirements for welding, appearance, quality of welds, and methods used in correcting welding work.

1. Protect GFRC panels from damage by field welding or cutting operations, and provide noncombustible shields as required.

E. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

3.3 ERECTION TOLERANCES

A. Erect GFRC panels to comply with the following noncumulative tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    b. Nonexposed Individual Panel: Plus or minus 1/2 inch (13 mm).
    c. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
    d. Nonexposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).

3. Support Elevation from Nominal Elevation: As follows:

    a. Maximum Low: 1/2 inch (13 mm).
    b. Maximum High: 1/4 inch (6 mm).

4. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet (30 m): 1 inch (25 mm).
5. Plumb in Any 10 Feet (3 m) of Element Height: 1/4 inch (6 mm).
6. Maximum Offset in Alignment of Matching Edges: 1/4 inch (6 mm).
7. Face Width of Joint: As follows (governs over joint taper):

    a. Panel Dimension 20 Feet (6 m) or Less: Plus or minus 1/4 inch (6 mm).
    b. Panel Dimension More Than 20 Feet (6 m): Plus or minus 3/8 inch (9.5 mm).

8. Maximum Joint Taper: 3/8 inch (10 mm).
9. Maximum Joint Taper in 10 Feet (3 m): 1/4 inch (6 mm).
10. Differential Bowing, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).

3.4 REPAIRS

A. Repairs are permitted provided structural adequacy of GFRC panel and appearance are not impaired, as approved by Architect.

B. Mix patching materials and repair GFRC so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces.

C. Prepare and repair accessible damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush and clean accessible weld areas on prime-painted components and paint with same type of shop primer.

E. Remove and replace damaged GFRC panels when repairs do not comply with requirements.

3.5 CLEANING AND PROTECTION

A. Perform cleaning procedures, if necessary, according to GFRC manufacturer's written instructions. Clean soiled GFRC surfaces with detergent and water, using soft fiber brushes and sponges, and rinse with clean water. Prevent damage to GFRC surfaces and staining of adjacent materials.

END OF SECTION 034900

SECTION 035113 - CEMENTITIOUS WOOD FIBER DECKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monolithic cementitious wood-fiber plank units.
2. Composite cementitious wood-fiber plank units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include details at supports, reinforcement at openings, and attachment to other work.

C. Samples: Show texture, finish, and edge and end configurations of each type of cementitious wood-fiber unit.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or 450 or less as directed.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Noise Reduction Coefficient (NRC): As directed.

D. Light Reflectance: 60 percent; ASTM E1349.

2.2 MONOLITHIC CEMENTITIOUS WOOD-FIBER PLANK UNITS

A. Monolithic Plank: Manufacturer's standard, tongue-and-groove-edged, cementitious wood-fiber units.
   1. Thickness: As directed.
   2. Size: Manufacturer's standard width; length to span a minimum of two supports as indicated.
   3. End Configuration: Square.
   4. Finish: Manufacturer's standard natural or prime-painted finish.

B. Channel-Reinforced Monolithic Plank: Manufacturer's standard, tongue-and-groove-edged, cementitious wood-fiber planks with factory-installed, cold-formed, 0.060-inch- (1.5-mm-) thick, galvanized-steel channel set in grooved edge; and as follows:
   1. Thickness: As directed.
   2. Size: Manufacturer's standard width; length to span a minimum of two support spacings as indicated.
   3. End Configuration: Square.

2.3 COMPOSITE CEMENTITIOUS WOOD-FIBER PLANK UNITS

A. Insulated Composite Plank: Manufacturer's standard factory-laminated composite deck units consisting of a standard tongue-and-groove-edged, cementitious wood-fiber plank base, ASTM C578, Type IV extruded-polystyrene insulation, and top layer of APA-rated oriented-strand-board sheathing, Exposure 1 complying with DOC PS 2, 7/16 inch (11 mm) thick; and as follows:
   1. Cementitious Wood-Fiber Base Thickness: As directed.
   2. Insulation Thickness: As directed.
   3. Size: Manufacturer's standard width and of length indicated.
   4. End Configuration: Square.
   5. Finish: Manufacturer's standard natural or prime-painted finish.

B. Insulated Composite Plank: Manufacturer's standard factory-laminated composite deck units consisting of a standard tongue-and-groove-edged, cementitious wood-fiber plank base, ASTM C578, Type I expanded-polystyrene insulation, and top layer of APA-rated oriented-strand-board sheathing, Exposure 1 complying with DOC PS 2, 7/16 inch (11 mm) thick; and as follows:
   1. Cementitious Wood-Fiber Base Thickness: As directed.
   2. Insulation Thickness: As directed.
   3. Size: Manufacturer's standard width and of length indicated.
   4. End Configuration: Square.
   5. Finish: Manufacturer's standard natural or prime-painted finish.

C. Composite Nailable Surface Plank: Manufacturer's standard factory-laminated composite deck units consisting of a standard tongue-and-groove-edged, cementitious wood-fiber plank base, insulation, and top layer of APA-rated oriented-strand-board sheathing, Exposure 1 complying with DOC PS 2, 7/16 inch (11 mm) thick.
   1. Thickness: As directed.

2. Size: Manufacturer's standard width and of length indicated.
3. End Configuration: Square.
4. Finish: Manufacturer's standard natural or prime-painted finish.

2.4 ACCESSORIES

A. Anchor Clips: Manufacturer's standard formed anchor clips of 0.0478-inch- (1.21-mm-) thick minimum, galvanized-steel sheet, of type and configuration required for deck system indicated.

B. Screws: Manufacturer's recommended corrosion-resistant screw fasteners and washers, self-drilling, self-tapping, of length required for deck and structural framing indicated.

C. Nails: Manufacturer's recommended corrosion-resistant nails of size and length required for deck and structural framing indicated.

D. Adhesive: Manufacturer's recommended construction adhesive complying with APA AFG-01.

E. Filler Strips: Insulation strips, same as used in manufacture of insulated composite cementitious wood-fiber units.

F. Polyethylene Film: 0.004 inch (0.10 mm) thick, complying with ASTM D4397.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine structural support framing for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Comply with manufacturer's written instructions for installing cementitious wood-fiber deck.

1. Install fastenings according to manufacturer's written instructions unless otherwise indicated as indicated.

C. Deck Interruptions: Provide barrier seals or blocking at overhangs to form wind seals and at partitions and walls to form sound seals unless otherwise indicated.

3.2 ROOF DECK INSTALLATION

A. Plank Roof Deck: Install planks progressively with long dimension perpendicular to supports and with end joints in alternate rows, staggered and centered over supports unless otherwise indicated. Tightly nest tongue-and-groove edges and tightly butt end joints.

1. Cut panels to provide starter units.
2. Continuously support plank edges and ends at perimeter of building and at openings in deck.
3. Mechanically fasten planks to supports and perimeter members.

4. Adhesively and mechanically fasten planks to supports and perimeter members. Apply adhesive to tongue-and-groove edges.

3.3 CLEANING AND PROTECTION

A. Protect top surfaces of deck from damage caused by construction operations.

B. Protect exposed bottom surfaces of deck from soiling and damage during handling and construction.

C. Clean exposed bottom surfaces of completed deck and touch up minor damage to surfaces as approved by Architect.

D. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that cementitious wood-fiber deck is without damage or deterioration at time of Substantial Completion.

E. Remove and replace deteriorated and damaged deck units.

END OF SECTION 035113

SECTION 035216 - LIGHTWEIGHT INSULATING CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place perlite aggregate lightweight insulating concrete.
2. Cast-in-place vermiculite aggregate lightweight insulating concrete.
3. Cast-in-place cellular foam lightweight insulating concrete.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for requirements for normal-weight and structural lightweight concrete, including formwork, reinforcement, and concrete materials and mixes.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For lightweight insulating concrete.

1. Include plans, sections, and details showing roof slopes, thicknesses, and embedded insulation board.
2. Indicate locations of penetrations, perimeter terminations and curbs, control and expansion joints, and drains.

C. Design Mixtures: For each lightweight insulating concrete mixture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed.

B. Product Certificates: For the following:

1. Cementitious materials.
2. Lightweight aggregates.
3. Foaming agents.
4. Admixtures.
5. Molded-polystyrene insulation board.

C. Evaluation Reports: For lightweight insulating concrete, from ICC-ES.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. NRDCA Installer Qualifications: A firm that has been evaluated by UL and found to comply with requirements of NRDCA's Lightweight Insulating Concrete Roof Deck Contractors Accreditation Program.

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1.7 FIELD CONDITIONS

A. Do not place lightweight insulating concrete unless ambient temperature is at least 40 deg F (4.4 deg C) or 32 deg F (0 deg C) and rising or as directed.

1. When air temperature has fallen or is expected to fall below 40 deg F (4.4 deg C), heat water to a maximum 120 deg F (49 deg C) before mixing so lightweight insulating concrete, at point of placement, reaches a temperature of 50 deg F (10 deg C) minimum and 80 deg F (27 deg C) maximum.

B. Do not place lightweight insulating concrete during rain or snow or on surfaces covered with standing water, snow, or ice.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. FM Global Listing: Lightweight insulating concrete along with other roofing components shall comply with requirements in FM Global 4454 as part of a roof assembly, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable.

2.2 AGGREGATE LIGHTWEIGHT INSULATING CONCRETE

A. Produce aggregate lightweight insulating concrete using the minimum amount of water necessary to produce a workable mix.

1. Do not exceed maximum air content recommended by aggregate manufacturer.

B. Perlite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and perlite mineral aggregates complying with ASTM C332, Group I.

1. As-Cast Unit Weight: 38 to 44 lb/cu. ft. (610 to 705 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
2. Oven-Dry Unit Weight: 24 to 30 lb/cu. ft. (385 to 480 kg/cu. m), when tested according to ASTM C495.
3. Compressive Strength: Minimum 125 psi (860 kPa), when tested according to ASTM C495.
4. Cement-to-Aggregate Ratio, by Volume: 1:6 or as directed..

C. Vermiculite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and vermiculite mineral aggregates complying with ASTM C332, Group I.

1. Asbestos Content: No detectable asbestos as determined by method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
2. As-Cast Unit Weight: 45 to 49 lb/cu. ft. (720 to 785 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
3. Oven-Dry Unit Weight: 23 to 26 lb/cu. ft. (370 to 416 kg/cu. m), when tested according to ASTM C495.
4. Compressive Strength: Minimum 140 psi (965 kPa), when tested according to ASTM C495.
5. Cement-to-Aggregate Ratio, by Volume: 1:6 or as directed.
6. As-Cast Unit Weight: 44 to 60 lb/cu. ft. (705 to 960 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
7. Oven-Dry Unit Weight: 22 to 28 lb/cu. ft. (352 to 450 kg/cu. m), when tested according to ASTM C495.
8. Compressive Strength: Minimum 125 psi (860 kPa), when tested according to ASTM C495.
9. Cement-to-Aggregate Ratio, by Volume: 1:6.
10. As-Cast Unit Weight: 60 to 68 lb/cu. ft. (960 to 1090 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
11. Oven-Dry Unit Weight: 34 to 42 lb/cu. ft. (545 to 673 kg/cu. m), when tested according to ASTM C495.
12. Compressive Strength: Minimum 300 psi (2070 kPa), when tested according to ASTM C495.
13. Cement-to-Aggregate Ratio, by Volume: 1:3.5.

2.3 CELLULAR LIGHTWEIGHT INSULATING CONCRETE

A. Produce cellular lightweight insulating concrete with the following minimum physical properties using cementitious materials, air-producing liquid-foaming agents complying with ASTM C869/C869M, and the minimum amount of water necessary to produce a workable mix:

1. As-Cast Unit Weight: 34 to 42 lb/cu. ft. (545 to 673 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
2. Oven-Dry Unit Weight: 26 to 32 lb/cu. ft. (416 to 513 kg/cu. m), when tested according to ASTM C495.
3. Compressive Strength: Minimum 190 psi (1310 kPa), when tested according to ASTM C495.
4. As-Cast Unit Weight: 40 to 48 lb/cu. ft. (641 to 770 kg/cu. m) at point of placement, when tested according to ASTM C138/C138M.
5. Oven-Dry Unit Weight: 32 to 40 lb/cu. ft. (513 to 641 kg/cu. m), when tested according to ASTM C495.
6. Compressive Strength: Minimum 250 psi (1723 kPa), when tested according to ASTM C495.

2.4 MATERIALS

A. Cementitious Material: Portland cement, ASTM C150/C150M, as directed.

B. Water: Clean, potable.

C. Joint Filler: ASTM C612, Class 2, glass-fiber type; compressing to one-half thickness under a load of 25 psi (172 kPa).

D. Steel Wire Mesh: Cold-drawn steel wire, galvanized, 0.041-inch (1.04-mm) diameter, woven into 2-inch (50-mm) hexagonal mesh, and reinforced with a longitudinal 0.062-inch- (1.57-mm-) diameter wire spaced 3 inches (75 mm) apart.

E. Galvanized Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, 2 by 2 inches (50 by 50 mm), W0.5 by W0.5, fabricated from galvanized-steel wire into flat sheets.

F. Molded-Polystyrene Insulation Board: ASTM C578, Type I, 0.90-lb/cu. ft. (14.4-kg/cu. m) minimum density.

1. Provide units with manufacturer's standard keying slots or holes of 3 to 4 percent of board's gross surface area.

2.5 DESIGN MIXTURES

A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.

1. Limit use of fly ash to not exceed 25 percent of portland cement by weight.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301 (ACI 301M).

PART 3 - EXECUTION

3.1 PREPARATION

A. Control Joints: Install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight insulating concrete. Fill control joints with joint filler.

1. Provide 1-inch- (25-mm-) wide control joints for roof dimensions up to 100 feet (30 m) in length; 1-1/2-inch- (38-mm-) wide control joints for roof dimensions exceeding 100 feet (30 m).

B. Wire Mesh: Place steel wire mesh with longest dimension perpendicular to steel deck ribs. Cut mesh to fit around roof openings and projections. Terminate mesh at control joints. Lap sides and ends of mesh at least 6 inches (150 mm).

C. Welded Wire Reinforcement: Place steel welded wire reinforcement with longest dimension perpendicular to steel deck ribs. Cut reinforcement to fit around roof openings and projections. Terminate reinforcement at control joints. Lap sides and ends of reinforcement at least 6 inches (150 mm).

3.2 MIXING AND PLACING

A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture and loss of air content.

B. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch (3 mm) over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards. Allow slurry coat to set prior to placing remaining thickness of lightweight insulating concrete.

1. Install insulation board in a stair-step configuration with a maximum step-down of 1 inch (25 mm).

C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.

D. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.

E. Begin curing operations immediately after placement, and air cure for not less than three days, according to manufacturer's written instructions.

F. If ambient temperature falls below 32 deg F (0 deg C), protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage as directed a qualified testing agency to sample materials and perform tests and inspections.

B. Testing of samples of lightweight insulating concrete obtained according to ASTM C172/C172M, except as modified by ASTM C495, shall be performed according to the following requirements:

1. Determine as-cast unit weight during each hour of placement, according to ASTM C138/C138M.
2. Determine oven-dry unit weight and compressive strength according to ASTM C495. Make a set of at least six molds for each day's placement, but not less than one set of molds for each 5000 sq. ft. (465 sq. m) of roof area.
3. Perform additional tests when test results indicate that as-cast unit weight, oven-dry unit weight, compressive strength, or other requirements have not been met.

    a. Retest cast-in-place lightweight insulating concrete for oven-dry unit weight and compressive strength.

C. Prepare test and inspection reports.

END OF SECTION 035216

SECTION 035300 - CONCRETE TOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Emery-aggregate concrete floor topping.
2. Iron-aggregate concrete floor topping.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each concrete floor topping, for tests performed by as directed.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated.

B. Mockups: Place concrete floor topping mockups to demonstrate typical joints, surface finish, bonding, texture, tolerances, and standard of workmanship.

1. Build mockups approximately 100 sq. ft. (9.3 sq. m) in the location indicated or, if not indicated, as directed by Architect.
2. If Architect determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.

1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between 50 and 86 deg F (10 and 30 deg C).

B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR TOPPINGS

A. Emery-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of graded, crushed emery aggregate containing not less than 50 percent aluminum oxide, not less than 24 percent ferric oxide, and not more than 8 percent silica; portland cement or blended hydraulic cement; plasticizers; and other admixtures to which only water needs to be added at Project site.

1. Compressive Strength (28 Days): 10,000 psi (69 MPa) or as directed; ASTM C109/C109M.

B. Iron-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of graded iron aggregate, portland cement, plasticizers, and other admixtures to which only water needs to be added at Project site.

1. Compressive Strength (28 Days): 12,000 psi (83 MPa) or as directed ASTM C109/C109M.

2.2 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, 25 percent solids content, minimum.

2.3 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids epoxy resin with a Type A Shore durometer hardness of 80 or aromatic polyurea with a Type A Shore durometer hardness range of 90 to 95 or as directed according to ASTM D2240.

B. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

C. Portland Cement: ASTM C150/C150M, Type I or II.

D. Sand: ASTM C404, fine aggregate passing No. 16 (1.18-mm) sieve.

E. Water: Potable.

F. Acrylic-Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

G. Epoxy Adhesive: ASTM C881/C881M, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

H. Power-Actuated Fasteners: Fastener systems with an evaluation report based on ICC-ES AC70.

2.4 MIXING

A. Bonding Slurry: Mix portland cement with water to a thick paint consistency.

B. Bonding Slurry: Mix 1 part portland cement and as directed parts sand with water and an acrylic-bonding agent according to manufacturer's written instructions to a thick paint consistency.

C. Floor Topping: Mix concrete floor topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Verify that base concrete slabs comply with scratch finish requirements specified in Section 033000 "Cast-in-Place Concrete."

C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D4263.

D. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of 1/4 inch (6 mm).

1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.
2. Mechanically remove contaminants from existing concrete that might impair bond of floor topping.
3. Saw cut contraction and construction joints in existing concrete to a depth of 1/2 inch (13 mm) and fill with semirigid joint filler.
4. To both sides of joint edges and at perimeter of existing base slab, mechanically remove a 4-inch- (100-mm-) wide and 0- to 1-inch- (0- to 25-mm-) deep, tapered wedge of concrete and retexture surface, install concrete nails in manufacturer's recommended staggered pattern as directed.

B. Install joint-filler strips where topping abuts vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with topping surface unless otherwise indicated.
2. Terminate full-width, joint-filler strips 1/2 inch (13 mm) below topping surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

C. Install power-actuated fasteners according to written directions of floor topping manufacturer at perimeter of areas that are to receive floor topping, including both edges of locations where joints will be formed in floor topping.

3.3 FLOOR TOPPING APPLICATION

A. Start floor topping application in presence of manufacturer's technical representative.

B. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Section 033000 "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.

C. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of 1/16 to 1/8 inch (1.6 to 3 mm), without puddling. Place floor topping while slurry is still tacky.

D. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of 1/16 to 1/8 inch (1.6 to 3 mm), without puddling. Place floor topping while adhesive is still tacky.

E. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.

1. Screed surface with a straightedge and strike off to correct elevations.
2. Slope surfaces uniformly where indicated.
3. Begin initial floating, using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

F. Finishing: Consolidate surface with power-driven floats as soon as concrete floor topping can support equipment and operator. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until concrete floor topping surface has a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power-driven trowel without allowing blisters to develop. Continue troweling passes and restraighten until surface is smooth and uniform in texture.

    a. Finish surfaces to specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15, and measure, and notify independent testing agency to permit measurement within 24 hours according to ASTM E1155 (ASTM E1155M) for a randomly trafficked floor surface.
    b. Finish and measure surface, so gap at any point between surface and an unleveled freestanding 10-foot- (3-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/4 inch (6 mm).

G. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.

1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.

H. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.

1. Form joints in concrete floor topping over contraction joints in base slabs unless otherwise indicated.
2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.

3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than 1/2 inch (13 mm) deep.

3.4 PROTECTING AND CURING

A. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.

C. Begin curing immediately after finishing concrete floor topping. Cure by one or a combination of the following methods, according to concrete floor topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with water, continuous water-fog spray or absorptive cover, water saturated and kept continuously wet. Cover topping surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.5 JOINT FILLING

A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.6 REPAIR

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage as directed a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of completed applications of concrete floor toppings shall take place in successive stages, in areas of extent and using methods as follows:

1. Sample Sets: At point of placement, a set of three molded-cube samples shall be taken from the topping mix for the first 1000 sq. ft. (93 sq. m), plus one set of samples for each subsequent 5000 sq. ft. (464 sq. m) of topping, or fraction thereof, but not less than six samples for each day's placement. Samples shall be tested according to ASTM C109/C109M for compliance with compressive-strength requirements.
2. Concrete floor topping shall be tested for delamination by dragging a steel chain over the surface.
3. Concrete floor topping shall be tested for compliance with surface flatness and levelness tolerances.

C. Remove and replace applications of concrete floor topping where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 035300

SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Self-leveling, gypsum cement underlayment for application below interior floor coverings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place gypsum cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E492 and classified according to ASTM E989 by an independent testing agency.

2.2 GYPSUM CEMENT UNDERLAYMENTS

A. Gypsum Cement Underlayment: Self-leveling, gypsum cement product that can be applied in minimum uniform thickness of 1/8 inch (3 mm) or as directed to match adjacent floor elevations.

1. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C219.
2. Compressive Strength: Not less than 2500 psi (17.2 MPa), 4000 psi (27.6 MPa) or 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C472.
3. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

2.3 ACCESSORIES

A. Sound Mat:

B. Sound Reduction Board:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or as directed) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 or as directed percent relative

humidity level measurement, or as recommended by gypsum cement underlayment manufacturer.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond; prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

G. Sound Control Mat and Board: Install sound control materials according to manufacturer's written instructions.

1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035413

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

C. Sustainable Design Submittals:

D. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E492 and classified according to ASTM E989 by an independent testing agency.

2.2 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
2. Compressive Strength: Not less than “as directed at 28 days when tested according to ASTM C109/C109M.
3. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

2.3 ACCESSORIES

A. Sound Mat:

B. Sound Reduction Board:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 or as directed percent

relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

G. Sound Control Mat and Board: Install sound control materials according to manufacturer's written instructions.

1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 040110 - MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning the following:

1. Unit masonry surfaces.
2. Stone surfaces.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) or as directed.

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) or as directed.

C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) or as directed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) or as directed for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.

B. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation, for removing paint from masonry.

C. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation, for removing paint coatings from masonry; containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.

2.3 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Nonglazed Masonry and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

C. Acidic Cleaner for Glazed Masonry and Polished Stone: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on polished granite and polished dolomite marble.

PART 3 - EXECUTION

3.1 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) to 50 feet (15 m) away as directed.

B. Proceed with cleaning in an orderly manner; work from bottom to top or top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover as required.

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.4 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using low, medium or high (as directed) pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold or hot water, as directed applied by low, medium or high pressure spray to remove chemicals and paint residue (as directed)
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by low, medium or high (as directed) pressure spray to remove chemicals and soil.
9. Retreat spots of remaining paint.

C. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low, medium or high (as directed) pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.

4. Rinse with cold or hot water applied by low, medium or high pressure spray (as directed) to remove chemicals and paint residue.

3.5 CLEANING MASONRY

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray (as directed).
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot water applied by low, medium or high pressure spray to remove detergent solution and soil (as directed).
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold or hot water applied by low-pressure spray (as directed).
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold or hot water applied by low, medium or high pressure spray (as directed) to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray (as directed).
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low, medium or high pressure spray to remove chemicals and soil as directed)
6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray (as directed).
2. Apply cleaner to surface in two applications by brush or low-pressure spray as directed.

3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup.
4. Rinse with cold or hot water applied by low, medium or high pressure spray to remove chemicals and soil as directed.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup.
4. Rinse with cold water applied by low, medium or high pressure spray to remove chemicals and soil as directed.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

F. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup.
4. Rinse with cold water applied by low, medium or high pressure spray to remove chemicals and soil as directed. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

G. One-Part Limestone Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray as directed.
2. Apply cleaner to surface by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup.
4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
5. Rinse with cold or hot water applied by medium-pressure spray to remove chemicals and soil (as directed).

END OF SECTION 040110

SECTION 040120.63 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Repairing brick masonry.
2. Removing abandoned anchors.
3. Painting steel uncovered during the work.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of bricks to freezing and thawing.

1.4 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for colored mortar immediately after approval of Samples or mockups. Take delivery of and store at Project site enough quantity to complete Project.

B. Work Sequence: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.

9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks according to "Brick Masonry Patching" Article. Patch holes in mortar joints according to Section 040120.64 "Brick Masonry Repointing."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of replacement bricks on the structure, showing relation of existing and new or relocated units.
2. Show provisions for expansion joints or other sealant joints.
3. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
4. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches (150 mm) long by 1/2 inch (13 mm) wide, set in aluminum or plastic channels.

    a. Have each set contain a close color range of at least three. Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
    b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

2. Sand Types Used for Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.

    a. Have each set contain a close color range of at least three Samples of different mixes of patching compound that matches the variations in existing masonry when cured and dry.

4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
2. Each type of patching compound in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Accessories: Each type of accessory and miscellaneous support.

1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For existing bricks and mortar and replacement bricks.

B. Quality-control program.

1.7 QUALITY ASSURANCE

A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.

1. Field Supervision: Brick masonry repair specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.
2. Brick Masonry Repair Worker Qualifications: When bricks are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four brick units replaced.

b. Patching: Three small holes at least 1 inch (25 mm) in diameter as directed for each type of brick indicated to be patched.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver bricks to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

F. Handle bricks to prevent overstressing, chipping, defacement, and other damage.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits: Repair brick masonry only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial

shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. Face Brick: As required to complete brick masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties

a. Physical Properties: According to ASTM C67 and as follows:

1) Compressive Strength: match existing.
2) 24-Hour Cold-Water Submersion Absorption: < match existing.
3) Five-Hour Boil Absorption: match existing.
4) Saturation Coefficient: match existing.
5) Initial Rate of Absorption: match existing.

b. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Brick Matching Architect's Sample: Units with colors, color variation within units, surface texture, and physical properties that match Architect's sample. Match existing units in size and shape.

a. Physical Properties: According to ASTM C67 and as follows:

1) Compressive Strength: match existing.
2) 24-Hour Cold-Water Submersion Absorption: < match existing.
3) Five-Hour Boil Absorption: match existing.
4) Saturation Coefficient: match existing.
5) Initial Rate of Absorption: match existing.

b. For Architect's sample that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range rather than brick that matches an individual color within that range.

3. Special Shapes:

   a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
   b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
   c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

4. Tolerances as Fabricated: According to tolerance requirements in ASTM C216, Type FBX or According to tolerance requirements in ASTM C216, Type FBS as directed.

B. Building Brick: ASTM C62, of same vertical dimension as face brick, for masonry work concealed from view.

1. Grade SW where in contact with earth.
2. Grade SW, MW, or NW for concealed backup.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Mortar Sand: ASTM C144.

1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.4 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
   1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.
   2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
   3. Formulate patching compound in colors and textures to match each brick being patched. Provide no fewer than three colors to enable matching of the color, texture, and variation of each unit.

2.5 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating as directed.

   1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning", SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" surface preparation according to manufacturer's literature or certified statement.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

   1. Previous effectiveness in performing the work involved.
   2. Minimal possibility of damaging exposed surfaces.
   3. Consistency of each application.
   4. Uniformity of the resulting overall appearance.
   5. Do not use products or tools that could leave residue on surfaces.

2.6 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand.
2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime, masonry cement or mortar cement.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime masonry cement or mortar cement.
4. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

3.3 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.

1. Remove items carefully to avoid spalling or cracking masonry.

2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:

    a. Cut or grind off item approximately 3/4 inch (20 mm) beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
    b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

3. Patch hole where each item was removed unless directed to remove and replace bricks.

3.4 BRICK REMOVAL AND REPLACEMENT

A. Remove bricks that are damaged, spalled, or deteriorated as directed. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 BRICK MASONRY PATCHING

A. Patch the following bricks unless another type of repair or replacement is indicated:

1. Bricks indicated to be patched.

B. Remove and replace existing patches where indicated

C. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.
9. Remove and replace patches with hairline cracks or that show separation from brick at edges, and those that do not match adjoining brick in color or texture.

3.6 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify County in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until County has had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.8 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120.63

SECTION 040120.64 - BRICK MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repointing joints with mortar.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project location.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.5 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide, unless otherwise indicated, for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, both or as directed where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime, masonry cement, mortar cement or as directed. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime, masonry cement, mortar cement or as directed. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 inch (1.6 mm), 1/8 inch (3 mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), 2 times joint width, 2-1/2 times joint width, not less than 1/2 inch (13 mm), not less than 3/4 inch (20 mm) or as directed and not less than that required to expose sound, unweathered mortar.

Do not remove unsound mortar more than 2 inches (50 mm)deep; consult Architect for direction.

2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.64

SECTION 040140.61 - STONE REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repairing stone masonry.

1.2 DEFINITIONS

A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of replacement stone units on the structure and their jointing.
2. Show partial replacement stone units (dutchmen).
3. Show provisions for expansion joints or other sealant joints.
4. Show replacement and repair anchors, including drilled-in pins.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.6 QUALITY ASSURANCE

A. Stone Repair Specialist Qualifications: Engage an experienced stone repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repair work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of stone repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

A. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, and shape that match existing stone.

1. Physical Properties for Granite, Limestone, Marble, Sandstone or as directed:

a. Compressive Strength: (As directed) according to ASTM C170/C170M.
b. Modulus of Rupture: (As directed) according to ASTM C99/C99M.
c. Absorption: (As directed) according to ASTM C97/C97M.
d. Bulk Specific Gravity: (As directed) according to ASTM C97/C97M.

2. For existing stone that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.
3. Quarry: Subject to compliance with requirements, provide stone from the original quarry – As directed.

a. Original Quarry: As directed.

B. Cutting New Stone: Cut each new stone so that, when it is set in final position, the rift or natural bedding planes will match the rift orientation of existing stones.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

E. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

1. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than stone units being repaired, and develops high bond strength to all types of stone.
2. Formulate patching compound in colors, textures, and grain to match stone being patched.

F. Cementitious Crack Filler: Ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.

G. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F (21 deg C), recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

2.3 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.4 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: 1 part portland cement, 1 part lime, and 6 parts sand or as directed.
2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated, with cementitious material limited to portland cement and lime, masonry cement or mortar cement or as directed.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime, masonry cement or mortar cement or as directed.
4. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to stone and store during stone repair. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair or is to be reused. Carefully remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units.

B. Support and protect remaining stonework that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole stone units as possible.

1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.

F. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.

G. Replace removed damaged stone with other removed stone in good condition, where possible, matching existing stone, including direction of rift or natural bedding planes. Do not use broken units unless they can be cut to usable size.

H. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

I. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type indicated or matching existing configuration.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
2. Rake out mortar used for laying stone before mortar sets according to Section 040140.62 "Stone Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.3 PARTIAL STONE REPLACEMENT

A. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

1. Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.
2. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
3. If backing stone becomes damaged further, remove damaged area and enlarge partial replacement as required.

B. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.

C. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 inch (1.6 mm) in width, and joints between partial replacement and other stones that match existing joints between stones.

D. Exposed Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch(6-mm) diameter, plain or threaded stainless-steel pins set into 1/4-inch(6-mm) diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone.

E. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch-(6-mm) diameter, plain or threaded stainless-steel pins set into 1/4-inch (6-mm) diameter holes drilled into backing stone and into, but not through, the partial replacement.

F. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.

G. Apply partial replacement while adhesive is still tacky and hold securely in place until adhesive has cured. Use temporary shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

H. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.4 STONE PLUG REPAIR

A. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

B. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that will fit into hole drilled in damaged stone with only minimum gap necessary for adhesive.

C. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.

D. Apply plug while adhesive is still tacky and hold securely in place until adhesive has cured.

E. Clean adhesive residue from exposed surfaces.

3.5 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch(6-mm) diameter, plain or threaded stainless-steel pins set into 1/4-inch(6-mm) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch(6-mm) diameter, plain or threaded stainless-steel pins set into 1/4-inch-(6-mm) diameter holes drilled into parent stone and into, but not through, the fragment.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

F. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.6 CRACK INJECTION

A. General: Comply with cementitious crack-filler manufacturer's written instructions.

B. Drill 1/4-inch (6-mm) diameter injection holes as follows:

1. Transverse Cracks Less Than 3/8 inch (9 mm) Wide: Drill holes through center of crack at 12 to 18 inches (300 to 500 mm) o.c.
2. Transverse Cracks More Than 3/8 inch (9 mm) Wide: Drill holes through center of crack at 18 to 36 inches (500 to 900 mm) o.c.
3. Delaminations: Drill holes at approximately 18 inches (500 mm) o.c. both vertically and horizontally.
4. Drill holes 2 inches (50 mm) deep.

C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

D. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.

E. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward.

Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.

F. Clean cementitious crack filler from face of stone before it sets by scrubbing with water.

G. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.

3.7 STONE PATCHING

A. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.

B. Mask adjacent mortar joint or rake out for repointing if patch will extend to edge of stone unit.

C. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

D. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.

E. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.
2. Carved Details: Build patch up 1/4 inch (6 mm) above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened.

F. Keep each layer damp for 72 hours or until patching compound has set.

G. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140.61

SECTION 040140.62 - STONE REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repointing joints with mortar.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.5 QUALITY ASSURANCE

A. Stone Repointing Specialist Qualifications: Engage an experienced stone repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of stone repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide unless otherwise indicated for each type of repointing required and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand, as directed. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type, as directed; with cementitious material limited to portland cement and lime, masonry cement or mortar cement. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type, as directed; with cementitious material limited to portland cement and lime, masonry cement or mortar cement. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to stone and store during stone repointing. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 inch (1.6 mm) or 1/8 inch (3 mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), 2 times joint width, 2-1/2 times joint width, not less than 1/2 inch (13 mm), not less than 3/4 inch (20 mm) and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.

2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140.62

SECTION 040310 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic clay brick, terra cotta and stone masonry surfaces.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and cleaning.
2. Review methods and procedures related to cleaning historic masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) or as indicated for each type of masonry and surface condition.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation for removing paint from masonry; containing no methylene chloride.

B. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from masonry.

C. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry; containing no methanol or methylene chloride.

D. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner based on phosphoric, oxalic, or citric acid; but not containing muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.

2.3 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick, Brownstone Terra Cotta and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

C. Acidic Cleaner Solution for Glazed Terra Cotta and Polished Stone: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage terra cotta surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

A. Have cleaning work performed only by qualified historic treatment specialist.

B. Proceed with cleaning in an orderly manner; work from bottom to top or top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

a. Equip units with pressure gauges.
b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

D. Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

1. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

F. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

G. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, caulking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and caulking with alkaline paint remover.

a. Comply with requirements in "Paint Removal" Article.
b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.4 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using low or medium pressure water spray, scrapers, stiff brushes, or a combination of these, as directed. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer.
5. Scrape off paint and remover.
6. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and paint residue, as directed.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed.

C. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low or medium pressure water spray, scrapers, stiff brushes, or a combination of these, as directed. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and paint residue, as directed.

D. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low or medium pressure water spray, scrapers, stiff brushes, or a combination of these, as directed. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.

3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer.
5. Scrape off paint and remover.
6. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and paint residue, as directed.

3.5 CLEANING BRICKWORK

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot water applied by low or medium pressure spray to remove detergent solution and soil, as directed.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove mold, mildew, and algae remover and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or as established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
6. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or two to three minutes, as directed.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

F. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.6 CLEANING BROWNSTONE TERRA COTTA

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot water applied by low or medium pressure spray to remove detergent solution and soil, as directed.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray, as directed.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove mold, mildew, and algae remover and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup, as directed.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
6. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply cleaner to surface in two applications]by brush or low-pressure spray as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to masonry in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

F. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.7 CLEANING GLAZED TERRA COTTA

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot] water applied by low or medium pressure spray to remove detergent solution and soil, as directed.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup, as directed.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
6. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

C. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply cleaner to terra cotta in two applications.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.

5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to terra cotta in two applications.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.8 CLEANING UNPOLISHED STONEWORK

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot water applied by low or medium pressure spray to remove detergent solution and soil, as directed.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray, as directed.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove mold, mildew, and algae remover and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.

3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup, as directed.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
6. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup, or of two to three minutes, as directed.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

F. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

G. One-Part Limestone Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply cleaner to surface by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup, as directed.

4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
5. Rinse with cold or hot water applied by medium-pressure spray to remove chemicals and soil, as directed.

3.9 CLEANING POLISHED STONEWORK

A. Detergent Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold or hot water applied by low or medium pressure spray to remove detergent solution and soil, as directed.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray, as directed.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove mold, mildew, and algae remover and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup, as directed.
4. Remove bulk of gel cleaner.
5. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
6. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold or hot water applied by low-pressure spray, as directed.

2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold or hot water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray, as directed.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup or of two to three minutes, as directed.
4. Rinse with cold water applied by low or medium pressure spray to remove chemicals and soil, as directed.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once or twice to observe progress and quality of the Work.

END OF SECTION 040310

SECTION 040322 - HISTORIC BRICK UNIT MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repairing historic clay brick masonry.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repair.
2. Review methods and procedures related to repairing historic brick masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.
2. Show full-size patterns with complete dimensions for new molded brick shapes and brick arches and their jointing, showing relationship of existing units to new units.
3. Show provisions for expansion joints or other sealant joints.
4. Show replacement and repair anchors. Include details of anchors

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction test reports.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic brick masonry repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

1. Historic Treatment Worker Qualifications: When bricks are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four brick units replaced.
b. Patching: Three small holes at least 1 inch (25 mm) in diameter or as directed for each type of brick indicated to be patched, so as to leave no evidence of repair.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on brick masonry as follows:

1. Replacement Brick: Test each proposed type of replacement brick, according to sampling and testing methods in ASTM C67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIAL

A. Salvaged brick.

2.2 MASONRY MATERIALS

A. Face Brick: Units, including molded, ground, cut, or sawed shapes as required to complete masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.

a. Physical Properties: According to ASTM C67 and as follows:

1) Compressive Strength: As directed.
2) 24-Hour Cold-Water Submersion Absorption: As directed.
3) Five-Hour Boil Absorption: As directed.
4) Saturation Coefficient: As directed.
5) Initial Rate of Absorption: As directed.

b. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

c. For Architect's sample that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range rather than brick that matches an individual color within that range.

2. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position, and where shapes produced by sawing would result in sawed surfaces being exposed to view.

b. Provide specially ground units, shaped to match patterns, for arches and where indicated.

c. Mechanically chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

B. Building Brick: ASTM C62, Grade SW where in contact with earth, Grade SW, MW, or NW for concealed backup; of same vertical dimension as face brick, for masonry work concealed from view.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. For exposed mortar, provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.4 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than the bricks being repaired, and develops high bond strength to all types of masonry.
2. Formulate patching compound used for patching brick in colors and textures to match each unit being patched. Provide sufficient number of or not less than three colors to enable matching the color, texture, and variation of each unit.

2.5 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

2.6 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand.

2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
4. Rebuilding (Setting) Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand.
5. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

3.3 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible. Remove mortar and sealant from surfaces of removed units.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets according to Section 040323 "Historic Brick Unit Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.4 BACKUP MASONRY REMOVAL AND REPLACEMENT

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged backup masonry units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Perform backup masonry removal and replacement according to requirements in "Brick Removal and Replacement" Article.

3.5 BRICK MASONRY PATCHING

A. Patch the following bricks unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.

4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.

B. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 (6) inch(es) (mm) thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.6 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040322

SECTION 040323 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing brick masonry joints.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.
2. Review methods and procedures related to repointing historic brick masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide as indicated for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. Provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
4. Pointing Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 (1.6) or 1/8 (3) inch(es) (mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.

g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), 2 times joint width, 2-1/2 times joint width, not less than 1/2 inch (13 mm) or not less than 3/4 inch (20 mm) and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 (50) inches (mm) deep; consult Architect for direction.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of bricks or widen joints. Replace or patch damaged bricks as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 (9) inch(es) (mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 (9) inch(es) (mm). Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing brick have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040323

SECTION 040326 - HISTORIC TERRA COTTA UNIT MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repairing historic terra cotta masonry.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repair.
2. Review methods and procedures related to repairing historic terra cotta masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.
2. Show full-size patterns with complete dimensions for new terra cotta units and their jointing, showing relationship of existing units to new units.
3. Indicate setting number of each new terra cotta unit and its location on the structure in annotated plans and elevations.
4. Show provisions for expansion joints or other sealant joints.

5. Show replacement and repair anchors. Include details of anchors within individual terra cotta units.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For replacement terra cotta units.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic terra cotta repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

1. Historic Treatment Worker Qualifications: When terra cotta units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Terra Cotta Manufacturer Qualifications: A firm regularly engaged in manufacturing custom architectural terra cotta units for building restoration purposes, of same type and of similar size, complexity, and tolerances as those required for the Work.

C. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Terra Cotta Repair: Prepare sample areas for each type of terra cotta material and assembly indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four terra cotta units replaced.
b. Patching: Three small holes at least 1 inch (25 mm) in diameter or as directed for each type of terra cotta indicated to be patched, so as to leave no evidence of repair.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on terra cotta masonry as follows:

1. Replacement Terra Cotta: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Glazed Terra Cotta: New terra cotta units that match existing terra cotta units in physical properties, color, gloss, surface texture, thickness, profile, dimensions, and composition of surface glaze.
   1. Physical Properties: According to ASTM C67 and as follows:

      a. Compressive Strength: As directed.
      b. 24-Hour Cold-Water Submersion Absorption: As directed.
      c. Five-Hour Boil Absorption: As directed.
      d. Saturation Coefficient: As directed.
      e. Initial Rate of Absorption: As directed.

B. Brownstone Terra Cotta: New, unglazed or translucent, slip-glazed, through-body colored, brownstone terra cotta units that match existing terra cotta units in physical properties, colors, color variation within units, surface texture, unit profile, and dimensions.
   1. Physical Properties: According to ASTM C67 and as follows:

      a. Compressive Strength: As directed.
      b. 24-Hour Cold-Water Submersion Absorption: As directed.
      c. Five-Hour Boil Absorption: As directed.
      d. Saturation Coefficient: As directed.
      e. Initial Rate of Absorption: As directed.

   2. For existing terra cotta that exhibits a range of colors or color variation within units, provide terra cotta that proportionally matches that range and variation rather than terra cotta that matches an individual color within that range.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both where required for color matching of mortar.

   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

   1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
   2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
   3. For exposed mortar, provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Terra Cotta Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching terra cotta masonry.
   1. Use formulation that is vapor and water permeable (equal to or more than the terra cotta unit), exhibits low shrinkage, has lower modulus of elasticity than the terra cotta units being repaired, and develops high bond strength to all types of masonry.
   2. Formulate patching compound used for patching terra cotta in colors and textures to match each unit being patched. Provide sufficient number of or no fewer than three colors to enable matching the color, texture, and variation of each unit.

B. Terra Cotta Glaze Replacement: High-solids, nonyellowing, fade-resistant, waterborne acrylic latex, polyurethane, or epoxy coating intended for exterior use as terra cotta glaze replacement. Product shall be custom mixed by manufacturer to match color and gloss of existing terra cotta glaze.

2.4 ACCESSORY MATERIALS

A. Terra Cotta Anchors: Type and size indicated or, if not indicated, to match existing, formed metal anchors in size and type. Fabricate anchors from Type 304 or Type 316 stainless steel.

B. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of terra cotta units, less the required depth of pointing materials unless removed before pointing.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

   1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand.
2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
4. Rebuilding (Setting) Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand.
5. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

3.3 TERRA COTTA REMOVAL AND REPLACEMENT

A. At locations indicated, remove terra cotta units that are damaged, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that was supported by removed units.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing backup, rotted wood, rusted metal, and other deteriorated items.

E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for terra cotta replacement.

F. Install replacement units into bonding and coursing pattern of existing units.

1. Do not cut or grind glazed terra cotta.
2. If minor cutting of replacement brownstone terra cotta is required, use a motor-driven grinder or saw designed to cut masonry with clean, sharp, unchipped edges. Do not cut or grind more than 1/8 (3) inch(es) (mm) along any edge.
3. Maintain joint width for replacement units to match existing joints.
4. Use setting buttons or shims to set units accurately spaced with uniform joints.

G. Set replacement units in a full bed of rebuilding (setting) mortar. Replace existing, formed metal anchors with new terra cotta anchors of size and type indicated or matching existing configuration.

1. Embed anchors in mortar, and fill voids behind units with mortar.
2. Tool exposed mortar joints in repaired areas to match joints of surrounding existing terra cotta.
3. Rake out mortar used for setting terra cotta before mortar sets according to Section 040327 "Historic Terra Cotta Unit Masonry Repointing." Point at same time as repointing of surrounding area.
4. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

H. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.4 TERRA COTTA PATCHING

A. Patch the following terra cotta units unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.
4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.

B. Patching Terra Cotta:

1. Remove deteriorated material as determined by sounding gently with a small hammer. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 (6) inch(es) (mm) thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of unit.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.

6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Do not apply patching compound over mortar joints. If patching compound bridges mortar joints, cut out joints after patching compound hardens.
8. Trowel, scrape, or carve surface of patch to match texture, details, and surrounding surface plane or contour of the unit. Shape and finish surface before or after curing, as determined by testing, to best match existing terra cotta.
9. Keep each layer damp for 72 hours or until patching compound has set.
10. After final layer of patching compound has cured, apply terra cotta glaze replacement according to manufacturer's written instructions. Apply two or more coats, as needed, to match glaze of adjacent terra cotta units.

3.5 TERRA COTTA GLAZE REPAIR

A. Repair the glaze on the following terra cotta units that are otherwise sound unless another type of repair or replacement is indicated:

1. Units indicated to have glaze repaired.
2. Units with abraded or chipped glaze.
3. Units with spots or areas of shallow deterioration greater than glaze thickness and less up to 1/16 (1.5) inch(es) (mm) deep.

B. Application: After other repairs have cured, apply terra cotta glaze replacement according to manufacturer's written instructions. Apply two or more coats, as needed, to match glaze of adjacent terra cotta units. Do not apply glaze to joint surfaces between units or within joints that will be mortared or sealed.

3.6 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040326

SECTION 040327 - HISTORIC TERRA COTTA UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing terra cotta masonry joints.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.
2. Review methods and procedures related to repointing historic terra cotta masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide as indicated for each type of repointing required and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. Provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
4. Pointing Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 (1.6) or 1/8 (3 inch(es) (mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.

g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), 2 times joint width, 2-1/2 times joint width, not less than 1/2 inch (13 mm) or not less than 3/4 inch (20 mm) and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 (50) inches (mm) deep; consult Architect for direction.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of terra cotta units or widen joints. Replace or patch damaged units as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 (9) inch(es) (mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 (9) inch(es) (mm). Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing terra cotta units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040327

SECTION 040336 - HISTORIC TREATMENT OF ADOBE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Repairing historic adobe masonry.
2. Painting historic adobe walls.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Harling: Verb denoting the traditional method of throwing plaster against a substrate material to improve contact and bonding with substrate.

B. Well Graded: An aggregate containing a full range of sizes.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic treatment of adobe masonry at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of adobe masonry.
2. Review methods and procedures related to historic treatment of adobe masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of adobe repair work on the structure.
2. Indicate final grading around exterior walls.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For adobe replacement units.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic adobe-masonry specialist with expertise in matching and performing the types of historic adobe repairs required. Experience only in installing and repairing nonearthen masonry or cement plaster is insufficient experience for adobe historic treatment work.

B. Mockups: Build mockups of historic treatment processes for each type of adobe masonry repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Locate mockups on existing walls where directed by Architect unless otherwise indicated or on temporary walls with similar conditions as the existing construction.
2. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of adobe repair and reconstruction under same conditions as the completed Work or as directed. Include at least the following:

    a. Plaster Replacement: Install 5-sq. ft. (0.5-sq. m) area of missing or delaminating plaster with texture matching the existing plaster
    b. Crack Repair 3 linear ft. (1 m) of plaster cracks.
    c. Unit Replacement: Replace four adobe units near base of wall to demonstrate repair of basal erosion.
    d. Painting: Paint 100-sq. ft. (9-sq. m) area of wall.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage or Engage a qualified testing agency to perform preconstruction testing on adobe masonry as follows:

1. Replacement Adobe: Test proposed adobe replacement units for the following:

    a. Compressive Strength: According to ASTM C67.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Adobe Unit Soundness: Adobe units at the time of placement shall be able to pass the following tests:

1. Knife-Penetration Test: Press the point of a pocketknife into side of unit. The knife shall not penetrate deeper than 1/8 inch (3.2 mm).

2. Drop Test: Drop whole unit on its corner onto firm, dry earth from a height of 36 inches (914 mm). The unit shall not break or shatter but slight corner chipping is allowed.
3. Test Frequency: Test two arbitrary units from each pallet of or for every 20 units delivered and whenever a unit exhibits excess moisture content or other weakening defect or as directed.

2.2 ADOBE REPLACEMENT UNITS

A. Site-Made Adobe Units: Formed from soil or designated and modified local soil as follows:

1. Soil-Mix Proportions: As specified in "Adobe Soil Mix" Article below.
2. Unit Size: 8 x 14 x 4 inches (203 x 356 x 102 mm), 8 x 12 x 4 inches (203 x 305 x 102 mm), 8 x 16 x 4 inches (203 x 406 x 102 mm), 9 x 18 x 4 inches (229 x 457 x 102 mm) 10 x 14 x 4 inches (254 x 356 x 102 mm) or 12 x 18 x 4 inches (305 x 457 x 102 mm as directed.
3. Moisture Content: Maximum four percent by weight as directed.
4. Shrinkage Cracks: Maximum of three shrinkage cracks in a unit, with no crack exceeding 3 inches (76 mm) in length or 1/8 inch (3.2 mm) in width.
5. Compressive Strength: 300 psi (2068 kPa), as directed for average of five units and a minimum 250 psi (1724 kPa), as directed for each individual unit when tested according to ASTM C67.
6. Modulus of Rupture: 50 psi (345 kPa) as directed for average of five units and a minimum 35 psi (241 kPa) as directed for each individual unit when tested according to the 2018 IBC.

B. Manufactured Adobe Units Unstabilized or Stabilized units of custom soil-mix proportions according to "Adobe Soil Mix" Article below:

1. Unit Size: 8 x 14 x 4 inches (203 x 356 x 102 mm), 8 x 12 x 4 inches (203 x 305 x 102 mm), 8 x 16 x 4 inches (203 x 406 x 102 mm), 9 x 18 x 4 inches (229 x 457 x 102 mm), 10 x 14 x 4 inches (254 x 356 x 102 mm), 12 x 18 x 4 inches (305 x 457 x 102 mm) as directed.
2. Moisture Content: Maximum four percent by weight as directed.
3. Shrinkage Cracks: Maximum of three shrinkage cracks in a unit, with no crack exceeding 3 inches (76 mm) in length or 1/8 inch (3.2 mm) in width.
4. Compressive Strength: 300 psi (2068 kPa) as directed for average of five units and a minimum 250 psi (1724 kPa) as directed for each individual unit when tested according to ASTM C67.
5. Modulus of Rupture: 50 psi (345 kPa) as directed for average of five units and a minimum 35 psi (241 kPa) as directed for each individual unit when tested according to the 2018 IBC.
6. Absorption Requirement for Stabilized Units: Maximum 2-1/2 percent absorption by weight when tested according to the 2018 IBC as directed.

2.3 ADOBE MORTAR

A. Adobe Mortar Mix: Made from adobe soil mixture according to "Adobe Soil Mix" Article below, without straw. Screen out debris and aggregate larger than sand according to the USDA's "Field Book for Describing and Sampling Soils."

2.4 ADOBE SOIL MIX

A. Soil-Mix Proportions:

1. Sand: 55-75 percent by volume and with a coarse to fine sand proportion of about 1:2 according to the particle-size classification of USDA's "Field Book for Describing and Sampling Soils.". Add adobe-mud sand if required to maintain proportion of clay.
2. Silt: 10-30 percent by volume.
3. Clay 15 percent by volume.
4. Screening: Screen out debris and aggregate larger than sand according to the USDA's "Field Book for Describing and Sampling Soils."
5. Straw: After screening, add straw to sand, silt, and clay mixture at the rate as directed by owner.

2.5 PLASTER

A. Site-Made Mud Plaster: Made from soil or designated and modified local soil as follows and using lime water as the liquid component:

1. Base Coats: Soil-Mix Proportions according to "Adobe Soil Mix" Article or as listed below:

    a. Sand: 55-75 percent by volume and with a coarse to fine sand proportion of about 1:2. Add additional adobe-mud sand if required to maintain proportion of clay.
    b. Silt: 10-30 percent by volume.
    c. Clay 15 percent by volume.
    d. Screening: Screen out debris and aggregate larger than sand according to the USDA's "Field Book for Describing and Sampling Soils."
    e. Straw: After screening, add straw to sand, silt, and clay mixture at the rate as directed by owner.

2. Finish Coats: Soil-mix proportions same as base coats except as follows:

    a. Sand: Use finish-coat sand.
    b. Straw: Omit straw.
    c. Pigment: Add pigment as required for color.
    d. Color: Match Architect's samples or as selected by Architect from full range of colors and color densities.

B. Site-Made Lime Plaster: Formed from lime putty and lime-plaster sand as proportioned as follows and using lime water as the liquid component:

1. Base Coats: 1 part lime putty, 3 parts sand or 1 part lime putty, 3 parts sand, and straw.

a. Add straw to mix at the rate as directed by owner and evenly distribute it without clumps.

2. Finish Coats: As required to match finish of design reference sample, 1 part lime putty, 2 parts finish-coat sand or 1 part lime putty, 2 parts finish-coat sand, pigment as required for color.

a. Color: Match Architect's sample or as selected by Architect from full range of colors and color densities.

C. Manufactured Mud Plaster: Prepackaged, unstabilized or lime-stabilized natural mud plaster having a record of long-term satisfactory performance when applied to adobe masonry or of custom soil-mix proportions according to "Adobe Soil Mix" Article.

1. Finish-Coat Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of colors and color densities.

2.6 PAINT

A. Site-Made Lime Whitewash: Mixture of 50 lb. (22.7 kg) hydrated lime mixed with water or cactus mucilage and water and 10 lb. (4.5 kg) of salt (sodium chloride) to the consistency of milk with two percent milkfat. Add pigment for required color to liquid component before mixing with dry components.

1. Color: Match Architect's sample, as selected by Architect from full range of colors and color densities or Natural white.

B. Manufactured Lime Whitewash: Prepackaged, lime-based whitewash having a record of long-term satisfactory performance when applied to adobe units or mud plaster and lime plaster.

1. Color: As indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from full range of colors and color densities or Natural white.

2.7 MATERIALS

A. Hydrated Lime: ASTM C206, Type S; or ASTM C207, Type S.

B. Quicklime: ASTM C5.

C. Lime Putty: Slaked hydrated lime, Slaked quicklime or factory-prepared lime putty according to ASTM C1489.

D. Lime Water: A fully saturated solution of calcium hydroxide, made by stirring hydrated lime or lime putty in clean water and removing the undissolved calcium hydroxide.

E. Adobe-Mud Sand: Washed, well graded, natural sand or manufactured sand with coarse to fine sand proportion of about 1:2 according to the particle-size classification of USDA's "Field Book

for Describing and Sampling Soils," except medium sand classification is included with coarse sand.

1. Finish-Coat Sand for Mud Plaster: Fine sand, Coarse sand or Match size, texture, and gradation appearance of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

F. Lime-Plaster Sand: ASTM C897.

1. Finish-Coat Sand for Lime Plaster: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

G. Pigments: Natural clays or ASTM C979/C979M and having a record of satisfactory performance in the required type of plaster or paint.

H. Straw: Clean, dry, mold-free, chopped straw.

I. Cactus Mucilage: Viscous liquid obtained by soaking cut-up, prickly pear cactus (genus "Opuntia") leaves (cladodes) in water or lime water for three days and straining out the cactus pieces. Use it quickly; discard mucilage that has begun to spoil as determined by an unpleasant odor.

J. Water: Potable and free of substances capable of damaging adobe or plaster or affecting lime-plaster set.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF ADOBE MASONRY, GENERAL

A. Have adobe work performed only by qualified historic treatment specialist.

B. Description: In treating historic adobe, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated adobe units and plaster that cannot be repaired.
2. Verify that substrate surface conditions are suitable for repairs.
3. Replace lost details in new adobe and plaster that replicate existing or indicated configurations.
4. Leave repaired adobe or plasterwork in proper condition for painting or applying other finishes as indicated.
5. Install temporary protective measures to protect historic surfaces that shall be treated later.

C. Illumination: Perform masonry and plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 PLASTER REMOVAL AND REPLACEMENT

A. Dismantle plaster that is delaminated (loose) or irreparably damaged or deteriorated to the limits indicated.

1. Verify extent of detachment of plaster that has not yet fallen by tapping on plaster surface and evaluating the hollow or solid resonance.
2. Carefully dismantle areas along straight edges, without damaging surrounding plasterwork.

B. Verify whether plaster is mud, lime, or another type, and the type of remaining adjacent plaster. Use same type of plaster for replacement work unless otherwise indicated.

C. Verify whether condition of substrate contributed to plaster failure. If substrate is too smooth, cut out every other or every third adobe masonry joint 1/2-inch (13 mm)) deep to key replacement plaster with the adobe and abrade adobe surface with stainless-steel-wire brush.

D. Dismantle furring, lath, and reinforcement materials if any in repair area.

E. Preparation for Plastering:

1. Clean substrate surfaces to remove dust, loose particles, grease, wax, oil, salts, waterborne staining, debris, and other foreign matter and deposits that could impair bond with replacement plaster. Do not apply plaster over deteriorated coatings.
2. Remove ridges and protrusions greater than 1/8 inch (3 mm) and fill depressions greater than 1/4 inch (6 mm) with adobe mud or plaster. Allow patch to set and dry.
3. Wet entire adobe substrate before applying each coat of plaster. Do not soak. Keep substrate damp to the touch but without visible water droplets.
4. Wet remaining plaster abutting the replacement plaster before installing new plasterwork. Do not soak.

F. Application: Apply mud plaster or lime plaster in one base coat and one finish coat, one base coat and two finish coats, two base coats and one finish coat or two base coats and two finish coats to a total thickness that aligns flush with remaining sound plaster.

1. Base-coat thickness: 3/8 to 3/4 inch (9 to 19 mm).
2. Finish-coat thickness: 3/16 to 3/8 inch (5 to 9 mm).
3. Dampen substrate for each coat with water or lime water in small areas as the work progresses.
4. Harl plaster or Harl first coat and trowel-apply remaining coat(s), pressing firmly.
5. Do not reuse plaster that has fallen to the ground.
6. Fully compact each coat and allow it to dry until it becomes thumbprint hard before scoring and applying next coat.
7. For mud plaster, cure (dry) each coat before applying next coat.
8. For lime plaster, allow each coat to set but not dry before applying next coat.

G. Cut back high areas and float or trowel plastered area level with wood trowel. Use plastic or metal trowel only for smooth-troweled finish.

H. Plaster Finish: Provide finish matching finish of remaining sound plaster, finish matching finish of design reference sample, smooth-troweled finish, smooth-float finish or sandy-float finish.

I. Finish plaster flush with lintels, rough frames of windows and doors, and other built-in items or accessories that act as a plaster ground unless otherwise indicated.

J. Tolerances: Completed plaster installation shall not deviate from a true plane by more than 1/8 inch (3 mm) as measured by a 5-foot (1.5-m) straightedge placed at any location on a surface, except where existing plaster is retained as a substrate for new plasterwork.

K. Cure mud plaster by sheltering the wall to ensure slow drying over three or five consecutive days, including weekends and holidays. Control the rate of curing to prevent cracking.

L. Cure lime plaster (initial curing) by maintaining repaired area in damp condition over five or seven consecutive days, including weekends and holidays.

M. Through-cracking within a plastered surface or separation at edge of a repair is unacceptable. Remove the repair and replace. Dismantle such work and reinstall or repair as a crack repair.

3.3 CRACK REPAIR

A. Cut out and repair cracks to the following extent:

1. All cracks in area indicated.
2. Cracks indicated on Drawings.
3. Cracks at locations of the following defects:

    a. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
    b. Cracks 1/16 inch (1.6 mm) or 1/8 inch (3 mm) or more in width and of any depth.
    c. Hollow-sounding cracks when tapped by metal object.
    d. Eroded crack surfaces 1/4 inch (6 mm) or more deep.
    e. Deterioration to point that wall material can be easily removed by hand, without tools.
    f. Cracks filled with substances other than adobe materials.

B. Cut out cracks as follows, according to procedures demonstrated in approved mockup:

1. Remove material from cracks to depth of 1 inch (25 mm) or 2 inches (51 mm) and not less than that required to expose sound, unweathered adobe. Do not remove unsound adobe more than 4 inches (102 mm) deep; consult Architect for direction.
2. Widen cracks only as necessary to fill them with repair mortar.
3. Remove adobe material within raked-out cracks to square off back of raked-out groove. Brush, vacuum, or flush cracks to remove dirt and loose debris.
4. Abrade smooth, side surfaces of crack, if any, by gouging (keying) the inside area of the crack.
5. Do not spall edges of adobe along sides of cut-out cracks.
6. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

C. Notify Architect of unforeseen detrimental conditions, including voids in wall construction, loose adobe units, rotted wood, rusted metal, and other deteriorated items.

D. Filling with Mortar: Use mud plaster or lime plaster.

1. Spray crack interior surfaces and adjacent adobe with water to dampen the wall and remove debris. Do not soak. Time spraying so that, at time of filling, prepared crack surfaces are damp but free of standing water.
2. Apply repair mortar first to areas where existing adobe was removed to depths greater than surrounding areas in the prepared groove. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to dry until thumbprint hard before applying next layer.

    a. For mud plaster, cure (dry) each layer before applying next layer.
    b. For lime plaster, allow each layer to set but not dry before applying next layer.

3. After deep areas have been filled to same depth as remaining cracks, point cracks by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow it to dry until thumbprint hard before applying next layer.

    a. For mud plaster, cure (dry) each layer before applying next layer.
    b. For lime plaster, allow each layer to set but not dry before applying next layer.

4. Do not spread mortar beyond repair edges onto adjacent adobe surfaces or featheredge the mortar.
5. Cure mud plaster by sheltering the wall to ensure slow drying over three or five consecutive days, including weekends and holidays. Control the rate of curing to prevent cracking.
6. Cure lime plaster (initial curing) by maintaining repaired area in damp condition over five or seven consecutive days, including weekends and holidays.

3.4 ADOBE UNIT REPLACEMENT

A. Description: Where backup masonry is fractured or unstable and at locations indicated, repair adobe masonry by removing adobe units that are broken or deteriorated and rebuilding with whole, new adobe construction. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with whole units.

1. Dismantle plaster that is delaminated (loose), irreparably damaged or deteriorated, and as required to exposed for replacement defective adobe units according to the requirements of "Plaster Removal and Replacement" Article above.

B. Shoring: Erect temporary shoring to protect and stabilize from movement the remaining construction above and around the adobe masonry being repaired.

1. Shore up ceilings and roofs above the work areas.
2. Shore up lintels, wood framing, bond beams, and grounds embedded in or supported by adobe masonry. Coordinate with new framing, bond beams, and wood repairs, which are specified in other Sections.
3. Remove shoring and bracing after repairs are complete.

C. Dismantling and Inspection: Inspect for excessive moisture in the adobe masonry assembly.

1. Dismantle crushed, softened, broken, and otherwise damaged adobe units and mortar.

2. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for adobe replacement.
3. Allow remaining and otherwise sound masonry to dry out before proceeding with the repair work.
4. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

D. Install new adobe units in sound condition, matching type of existing units. Do not use new, broken units unless they can be cut to usable size.

1. Install adobe replacement units into bonding and coursing pattern of existing units.
2. Install units with concave side down.
3. If cutting is required, use saw capable of cutting adobe with clean, sharp, unchipped edges.

E. Preparation for Setting Units and Mortaring: Prepare wall cavity by spraying dry areas to damp yet firm condition and without visible water droplets.

1. Spray new adobe units and repair area with water so that surfaces are damp yet firm and free of standing water. Do not soak units or wall cavity. If water dries, spray surfaces again before infilling the repair area.

F. Setting Units and Mortaring: Prepare a low-moisture adobe mortar mix (dry mix) with about five percent water content. Use this mix, well compacted, to completely fill bed, head, and collar joints.

1. Set new adobe units tightly into position with wood shims. Place units against fresh mortar in collar joint when filling partial wall thickness.
2. Install low-moisture mortar in layers and compact tightly.
3. Remove shims and fill the voids with low-moisture mortar, compacted in layers.

G. Finishing: Finish flat surfaces flush with adjacent adobe. For molded shapes, tool adobe surface to restore the shape and edge contours.

H. Cure repaired adobe masonry by sheltering the wall to ensure slow drying over seven or 10 consecutive days, including weekends and holidays before replastering or painting.

3.5 PAINTING

A. Preparation: Clean substrate surfaces to remove dust, loose particles, grease, wax, oil, salts, waterborne staining, debris, and other foreign matter and deposits that could impair bond. Do not apply whitewash over deteriorated coatings.

1. Spray substrate surface with water to dampen it. Do not soak. If water dries, spray prepared surfaces again before painting.

B. Application: Apply whitewash in two or three thin coats using a wide, natural-fiber or nylon brush or large pieces of clean burlap. Do not use both brush and burlap to apply whitewash.

1. Work first coat well into the pores of the substrate.
2. Apply succeeding coats when previous coat has begun to dry but is still damp. Mist lightly if necessary.
3. Alternate direction of application from vertical to horizontal, with the last coat applied horizontally.
4. Minimize overlaps and holidays in each coat.

C. Cure whitewash by sheltering the wall to ensure slow drying over three or five consecutive days, including weekends and holidays.

END OF SECTION 040336

SECTION 040342 - HISTORIC STONE MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repairing historic stone assemblies.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.
3. Section 040345 "Historic Stone Consolidation Treatment" for repair of stone using chemical consolidation.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa), as directed.
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s), as directed.

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to stone historic treatment and repair.
2. Review methods and procedures related to repairing historic stone masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of stone repair work on the structure.
2. Indicate complete dimensions for new stone units and their jointing, showing relation of existing to new units.

3. Indicate setting number of each new stone unit and its location on the structure in annotated plans and elevations.
4. Show provisions for expansion joints or other sealant joints.
5. Show replacement and repair anchors, including drilled-in pins.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For replacement stone types.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic stone repair specialist. Experience installing standard unit masonry or new stone masonry is insufficient experience for stone historic treatment work.

1. Historic Treatment Worker Qualifications: When stone units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four stone units replaced.
b. Partial Stone Replacement: Two partial stone replacements (dutchman repairs).
c. Stone Plug Repair: Two stone plug repairs for each type of stone indicated to be plugged.
d. Patching: Three small holes at least 1 inch (25 mm) in diameter as directed for each type of stone indicated to be patched, so as to leave no evidence of repair.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on stone masonry as follows:

1. Replacement Stone: Test each proposed type of replacement stone, according to ASTM C170/C170M for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C99/C99M for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C97/C97M for absorption and bulk specific gravity.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, and shape that match existing stone.

1. Physical Properties for Granite, Limestone, Marble or Sandstone:

    a. Compressive Strength: According to ASTM C170/C170M.
    b. Modulus of Rupture: According to ASTM C99/C99M.
    c. Absorption: According to ASTM C97/C97M.
    d. Bulk Specific Gravity: According to ASTM C97/C97M.

2. For existing stone that exhibits a range of colors, textures, grains, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.
3. Quarry: Subject to compliance with requirements, provide stone from the original quarry or as directed.

    a. Original Quarry or as directed.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. For exposed mortar, provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Stone-Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all stone types.
2. Formulate patching compound in colors, textures, and grain to match stone being patched. Provide sufficient number of or no fewer than three colors to enable matching each piece of stone.

B. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F (21 deg C), recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

2.4 ACCESSORY MATERIALS

A. Stone Anchors and Pins: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate from Type 304 or Type 316 stainless steel, as directed.

B. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand, as directed.

2. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
3. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
4. Rebuilding (Setting) Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand, as directed.
5. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding stone and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 STONE REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

3.3 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair or is to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that was supported by removed stone.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole stone units as possible. Remove mortar and sealant from surfaces of removed stones.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.

G. Replace removed damaged stone with other removed stone in good condition, where possible, matching existing stone. Do not use broken units unless they can be cut to usable size.

H. Rift: Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, the rift or natural bedding planes are predominantly horizontal, except for arches, where bedding planes are predominantly radial or vertical, but perpendicular to the wall. Reject stone with vertical bedding planes, except as required for arches, lintels, and copings.

I. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

J. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors of size and type indicated or matching existing configuration, as directed.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
2. Rake out mortar used for laying stone before mortar sets according to Section 040343 "Historic Stone Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

K. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.4 PARTIAL STONE REPLACEMENT

A. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

1. Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.
2. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
3. If backing stone becomes further damaged, remove damaged area and enlarge partial replacement as required.

B. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 (1.6) inch (mm)in width, and to produce joints between partial replacement and other stones that match existing joints between stones.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain or threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone.

1. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in backing stone and 2 inches (50 mm) in partial replacement, with end countersunk at least 3/4 inch (19 mm) from exposed face of partial replacement.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain or threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into backing stone and into, but not through, the partial replacement.

1. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in backing stone and 2 inches (50 mm) in partial replacement, but no closer than 3/4 inch (19 mm) from exposed face of partial replacement.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.

F. Apply partial replacement while adhesive is still tacky, and hold securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.5 STONE PLUG REPAIR

A. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

B. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that fits into hole drilled in damaged stone, with only minimum gap necessary for adhesive.

C. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.

D. Apply plug flush with surrounding stone while adhesive is still tacky, and hold securely in place until adhesive has cured.

E. Clean adhesive residue from exposed surfaces.

3.6 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain or threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone.

1. Center and space pins 3 to 5 inches (75 to 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in parent stone and 2 inches (50 mm) in fragment, with end countersunk at least 3/4 inch (19 mm) from exposed face of fragment.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, plain or threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into parent stone and into, but not through, the fragment.

1. Center and space pins 3 to 5 inches (75 to 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in parent stone and 2 inches (50 mm) in fragment, but no closer than 3/4 inch (19 mm) from exposed face of fragment.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

F. Fit stone fragment onto parent stone while adhesive is still tacky, and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.7 STONE PATCHING

A. Patch the following stone units unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.
4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and over 1/4 inch (6 mm) deep.

B. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or

slightly undercut edges on area to be patched and is at least 1/4 (6) inch (mm) thick, but not less than as recommended in writing by patching compound manufacturer.

C. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of stone unit.

D. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

E. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.

F. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.
2. Carved Details: Build patch up 1/4 inch (6 mm) above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened.

G. Keep each layer damp for 72 hours or until patching compound has set.

H. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040342

SECTION 040343 - HISTORIC STONE MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of repointing stone masonry joints.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.
2. Review methods and procedures related to repointing historic stone masonry.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide as indicated for each type of repointing required and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray or both, where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. Provide sand with rounded edges.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: ASTM C270, potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of

performance. Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 2 parts lime, and 7 parts sand or 1 part portland cement, 4 parts lime, and 12 parts sand. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N or Type O unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
4. Pointing Mortar by ASTM C1713 Composition: ASTM C1713, with binder material limited to portland cement and lime, and with a volume ratio of 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding stone and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone repointing work. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 STONE REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 (1.6) or 1/8 (3) inch (mm) or more in width and of any depth.

d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm), 2 times the joint width, 2-1/2 times the joint width, not less than 1/2 inch (13 mm) or not less than 3/4 inch (20 mm) and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 (50) inches (mm) deep; consult Architect for direction.
2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 (9) inch (mm)until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 (9) inch (mm). Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040343

SECTION 040345 - HISTORIC STONE CONSOLIDATION TREATMENT.

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of stone consolidation treatment.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and stone consolidation at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and stone consolidation.
2. Review methods and procedures related to stone consolidation treatment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified stone consolidation treatment specialist. Experience applying standard coatings or sealers is insufficient experience for stone consolidation treatment work.

B. Consolidant Manufacturer Qualifications: A firm regularly engaged in producing stone consolidants that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of consolidation treatment to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Apply stone consolidation treatment to an area approximately 4 sq. ft. (0.4 sq. m) or as indicated.

PART 2 - PRODUCTS

2.1 STONE CONSOLIDATION MATERIALS

A. Stone Consolidation Treatment: Ready-to-use product designed for consolidation of stone that has deteriorated from weathering and exposure to pollutants. Active ingredients shall be based on silicic ethyl esters.

B. Stone Consolidation and Water-Repellent Treatment: Ready-to-use product designed for consolidation and water-repellent treatment of stone that has deteriorated from weathering and exposure to pollutants. Active ingredients shall be based on silicic ethyl esters and a silane water repellent.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent consolidation treatment from contacting face of surrounding stone, not indicated to be treated, and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone consolidation treatment. Reinstall when consolidation treatment is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 CONSOLIDATION TREATMENT, GENERAL

A. Have stone consolidation work performed only by qualified historic treatment specialist.

3.3 STONE CONSOLIDATION TREATMENT

A. Apply treatment to clean, dry surfaces according to manufacturer's written instructions. Remove areas of blind exfoliation, delamination, and flaking before applying.

B. Apply in cycles to small sections of stonework, not more than 100 sq. ft. (9 sq. m) in area. Each cycle shall consist of three successive saturating applications, applied at five- to 15-minute intervals depending on drying conditions.

C. Apply by low-pressure spray to point of rejection in each application. Apply from bottom of the section to top.

D. Apply three cycles, allowing treated surface to dry for 60 to 90 minutes between cycles.

E. Protect treated surfaces from precipitation for 48 hours after treatment.

F. Allow treated surfaces to dry for at least 21 days before repointing, patching, or applying water repellents or sealants.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage consolidant manufacturers' factory-authorized service representatives for consultation and Project-site inspection and provide on-site assistance when requested by Architect.

END OF SECTION 040345

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Concrete building brick.
3. Decorative concrete masonry units.
4. Pre-faced concrete masonry units.
5. Concrete face brick.
6. Clay face brick.
7. Building (common) brick.
8. Hollow brick.
9. Glazed brick.
10. Structural clay facing tile.
11. Firebox brick.
12. Clay flue lining units.
13. Stone trim units.
14. Mortar and grout.
15. Steel reinforcing bars.
16. Masonry-joint reinforcement.
17. Ties and anchors.
18. Embedded flashing.
19. Miscellaneous masonry accessories.
20. Masonry-cell fill.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for dovetail slots for masonry anchors.
2. Section 042300 "Glass Unit Masonry" for glass block.
3. Section 044200 "Exterior Stone Cladding" for stone trim secured with stone anchors.

4. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
5. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
6. Section 072100 "Thermal Insulation" for cavity wall insulation.
7. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
8. Section 089516 "Wall Vents" for wall vents (brick vents).
9. Section 096313 "Brick Flooring" for interior brick flooring.
10. Section 096313.35 "Chemical-Resistant Brick Flooring" for chemical-resistant, interior brick flooring.
11. Section 097519 "Stone Trim" for stone window stools.
12. Section 321400 "Unit Paving" for exterior unit masonry paving.
13. Section 323223 "Segmental Retaining Walls" for dry-laid, concrete unit retaining walls.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Pre-faced CMUs.
3. Concrete face brick, in the form of small-scale units.
4. Clay face Hollow brick, in the form of straps of five or more bricks.
5. Glazed brick.
6. Glazed structural clay tile.
7. Stone trim.
8. Colored mortar.
9. Weep holes/cavity vents.

1.5 INFORMATIONAL SUBMITTALS

A. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

    a. Include data on material properties material test reports substantiating compliance with requirements as directed.
    b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    c. For exposed brick, include test report for efflorescence according to ASTM C67.
    d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Sample Panels: Where directed, Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for when directed in sizes approximately 48 inches (1200 mm) long by 36 inches (900 mm).
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged or bullnose units for outside corners as directed.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units an where indicated.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a.

C. Insulated CMUs: Where indicated, units shall contain rigid, specially shaped, molded-polystyrene insulation units complying with ASTM C578, Type I, designed for installing in cores of masonry units.

D. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa) or as directed..
2. Density Classification: Normal weight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

E. Concrete Building Brick: ASTM C55.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa) or as directed.
2. Density Classification: Normal weight.
3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-3/4 inches (70 mm) high by 7-5/8 inches (194 mm) long.

F. Decorative CMUs: ASTM C90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).or as directed
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
4. Pattern and Texture:

    a. Standard pattern, ground-face finish
    b. Standard pattern, split-face finish
    c. Standard pattern, split-ribbed finish
    d. Scored vertically so units laid in running bond appear as square units laid in stacked bond, standard finish.
    e. Triple scored vertically so units laid in running bond appear as vertical units laid in stacked bond (soldier courses), standard finish.

5. Colors: as Directed.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

G. Pre-faced CMUs: Lightweight hollow concrete units complying with ASTM C90, with manufacturer's standard smooth resinous facing complying with ASTM C744.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPaor as directed.
2. Size: Manufactured to dimensions specified in "CMUs" Paragraph but with pre-faced surfaces having 1/16-inch- (1.5-mm-) wide returns of facing to create 1/4-inch- (6.5-mm-) wide mortar joints with modular coursing.
3. Colors and Patterns: as directed.

H. Concrete Face Brick: ASTM C1634.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3750 psi (25.86 MPa) or as directed.
2. Density Classification: Normal weight or as directed.
3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-3/4 inches (70 mm) high by 11-5/8 inches (295 mm) long or as directed.

4. Texture: Split-face finish or as directed.

    a. Match Architect's samples.

5. Colors: As directed.
6. Special Aggregate: Provide units made with aggregate matching aggregate as idrected.

2.5 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).
1. Grade: MW or SW.
2. Type: FBX or HBX or as directed.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa) or as directed.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67.
5. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
6. Size (Actual Dimensions): 2-3/4 inches (70 mm) wide by 2-3/4 inches (70 mm) high by 8 inches (203 mm) long or as directed
7. Application: Use where brick is exposed unless otherwise indicated.

8. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1700 psi (11.72 MPa)or as directed.

C. Glazed Brick: Facing brick complying with ASTM C216, with glaze complying with ASTM C126; Single-fired glazed brick complying with ASTM C1405, Division Solid; Hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area), with glaze complying with ASTM C126; or single-fired glazed brick complying with ASTM C1405, Division H40V (void areas between 25 and 40 percent of gross cross-sectional area).
   1. ASTM C216: Grade MW or SW.
   2. ASTM C216: Type FBSor Type FBA.
   3. ASTM C652: Grade MW or SW.
   4. ASTM C652: Type HBS or Type HBA.
   5. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 8 inches (203 mm) long or as directed.
   6. Provide Type I (single-faced units) where only one finished face is exposed when units are installed, and Type II (double-faced units) where two opposite finished faces are exposed when units are installed.
   7. Application: Use where brick is exposed unless otherwise directed.
   8. Colors: As directed

2.7 STRUCTURAL CLAY FACING TILE

A. General:

   1. Provide solid, multicored, or hollow units, with shape and direction of cores optional unless otherwise indicated.
   2. Where reinforced masonry is indicated, provide multicored units designed for use in reinforced, grouted masonry, either with vertical cores and with webs notched to receive horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.
   3. Where indicated for exterior applications, provide units recommended by manufacturer for exterior use in Project's location.
   4. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.

      a. Provide square-edged units for outside corners unless otherwise directed.
      b. Provide coved internal corners.
      c. Provide recessed, coved base units.

   5. Where direct application of plaster is indicated or where bonded to backup masonry, provide units with rough, combed, or scored faces.

B. Glazed Structural Clay Facing Tile: ASTM C126, Grade S (Select).
   1. Sizes: 6P Series actual face dimensions of 3-5/8 inches (92 mm) high by 11-5/8 inches (295 mm) long by widths indicated or as directed.
   2. Width: Manufactured to dimensions 5/16 inch (8 mm) less than nominal dimensions.

C. Unglazed Structural Clay Facing Tile: ASTM C212, Type FTX, Standard class.
   1. Number of Faces: Single faced, where only one finished face is exposed when units are

2.8 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
   1. Exterior Walls: Hot-dip galvanized carbon steel.
   2. Wire Size for Side Rods: 0.148-inch (3.77-mm) or 0.187-inch (4.76-mm) diameter.
   3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) or 0.187-inch (4.76-mm) diameter.
   4. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) or 0.187-inch (4.76-mm) diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
   6. Provide in lengths of not less than 10 feet (3 m.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:
   1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches (100 mm) wide, plus one side rod at each wythe of masonry 4 inches (100 mm) wide or less.
   2. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch (16-mm) cover on outside face.
   3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch (1.5 mm) and maximum vertical adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

F. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized carbon steel continuous wire.

2.9 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

   1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
   2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.

3. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
4. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
6. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

C. Corrugated-Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.030-inch- (0.76-mm-)thick steel sheet, galvanized after fabrication.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
3. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

F. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

G. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

H. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

I. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- (4.76-mm-)0.25-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with a projecting vertical tab having a slotted hole for inserting wire tie.
6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.
7. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 9 inches (229 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.
8. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.
9. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs.
10. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
11. Seismic Masonry-Veneer Anchors: Connector section and rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having slotted holes for inserting vertical leg of connector section. Connector section consists of a rib-

stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire.

12. Seismic Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section. Wire tie has sheet metal clip welded to it with integral tabs designed to engage continuous wire.

13. Seismic Masonry-Veneer Anchors: Connector section and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting connector section. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs. Connector section consists of a triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Fabricate wire connector sections from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized, carbon steel wire.

14. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.
15. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

6. Fabricate through-wall flashing with drip edge unless otherwise directed. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.
7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
9. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.
10. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
11. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
12. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) or 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) or 7-oz./sq. ft. (2-kg/sq. m) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.

   a.

3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm).
   a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.76 mm).
   a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

5. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
   a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.02 mm) thick.
   b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of adhesive.
   c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of rubberized-

asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches (38 mm) from edge.

1) Color: As directed.

d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

6. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch (1.02 mm) thick.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

1. Solder for Stainless Steel: As directed ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
2. Solder for Copper: ASTM B32, Grade Sn50 with maximum lead content of 0.2 percent.
3. Elastomeric Sealant: ASTM C920, chemically curing urethane, polysulfide or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

F. Termination Bars for Flexible Flashing: Aluminum or Stainless steel bars 0.075 inch by 1 inch (1.90 mm by 25 mm).

G. Termination Bars for Flexible Flashing: Stainless steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8 inch (10-mm) sealant flange at top.

H. Termination Bars for Flexible Flashing: Aluminum sheet 0.064 inch by 1-1/2 inches (1.63 mm by 38 mm) with a 3/8-inch (10-mm) sealant flange at top.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.
3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches (9 by 38 by 89 mm) long.
4. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

6. Aluminum Weep Hole/Vent: Units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel, with louvers stamped in web and with a top flap to keep mortar out of the head joint; factory primed and painted before installation to comply with Section 099113 "Exterior Painting" in color selected by Architect.

7. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

a.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

b. Strips, not less than 3/4 inch (19 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips, full depth of cavity and installed to full height of cavity.
d. Sheets or strips not less than 3/4 inch (19 mm) thickness as directed and installed to full height of cavity, with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

2.12 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.13 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion or Property Specification as directed. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type M.
3. For mortar parge coats, use Type S.

4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:

    a. Decorative CMUs.
    b. Pre-faced CMUs.
    c. Concrete face brick.
    d. Clay face brick.
    e. Hollow brick.
    f. Glazed brick.
    g. Glazed structural clay facing tile.
    h. Stone trim units.
    i. Cast-stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

    a. Decorative CMUs.
    b. Pre-faced CMUs.
    c. Concrete face brick.
    d. Clay face brick.
    e. Hollow brick.
    f. Glazed brick.
    g. Glazed structural clay facing tile.
    h. Stone trim units.
    i. Cast-stone trim units.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C143/C143M.

G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:

a. Pre-faced CMUs.
b. Glazed brick.
c. Glazed structural clay facing tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: As directed.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.

2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Lay structural clay tile as follows:

1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch- (6- to 10-mm-) thick joints.

D. Set firebox brick in full bed of refractory mortar with full head joints. Form joints by buttering both surfaces of adjoining brick and sliding it into place. Make joints just wide enough to accommodate variations in size of brick, approximately 1/8 inch (3 mm). Tool joints smooth on surfaces exposed to fire or smoke.

E. Install clay flue liners to comply with ASTM C1283. Install flue liners ahead of surrounding masonry. Set clay flue liners in full bed of refractory mortar 1/16 to 1/8 inch (1.6 to 3 mm) thick. Strike joints flush on inside of flue to provide smooth surface. Maintain expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners.

F. Set stone or cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

G. Rake out mortar joints at pre-faced CMUs, glazed brick and glazed structural clay tile to a uniform depth of 1/4 inch (6 mm) and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

H. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch (19 mm) or more in width.

I. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

J. Cut joints flush where indicated to receive waterproofing, cavity wall insulation and air barriers unless otherwise indicated.

3.6 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods as follows:

1. Individual Metal Ties: As directed provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m), 2.67 sq. ft. (0.25 sq. m) or 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 36 inches (914 mm), 24 inches (610 mm) or 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes or tab-type reinforcement as directed.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. As directed space headers not more than 8 inches (203 mm) or 12 inches (305 mm) clear horizontally and 16 inches (406 mm) clear vertically.

B. Bond wythes of composite masonry together using bonding system indicated on Drawings.

C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

D. Collar Joints in Clay Tile Masonry: After each course is laid, fill the vertical, longitudinal joint between wythes solidly with mortar at exterior walls, except cavity walls, and interior walls and partitions.

E. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

F. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. As directed provide individual metal ties not more than 8 inches (203 mm) or 16 inches (406 mm) o.c.
2. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.
3. As directed provide rigid metal anchors not more than 24 inches (610 mm) or 48 inches (1220 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods as follows:

1. Individual Metal Ties: As directed provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m), 2.67 sq. ft. (0.25 sq. m) or 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 36 inches (914 mm), 24 inches (610 mm) or 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

    a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes or tab-type reinforcement as directed.
    b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
    c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) or 12 inches (305 mm) clear horizontally and 16 inches (406 mm) clear vertically.
4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
5. As directed space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 25 inches (635 mm) o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. (0.25 sq. m) or 3.5 sq. ft. (0.33 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.
6. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and horizontally. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 24 inches (610 mm), around perimeter.

B. Provide not less than 2 inches (50 mm) or 1 inch (25 mm) of airspace between back of masonry veneer and face of sheathing or insulation as directed.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.9 MASONRY-CELL FILL

A. As directed pour loose-fill insulation or lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet (6 m).

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.10 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.12 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.13 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.14 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where directed. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm), and through inner wythe to within

1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.

3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm), and 1-1/2 inches (38 mm) into the inner wythe
4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under water-resistive barrier or air barrier, lapping at least 4 inches (100 mm).
5. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
7. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products or open-head joints to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or wicking material 16 inches (400 mm) o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches (600 mm) above top of pea gravel.

G. Place cavity drainage material in cavities and airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products or open-head joints to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.15 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength as directed.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

J. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.17 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.18 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Pre-faced concrete masonry units.
4. Steel reinforcing bars.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

C. Samples: For each type and color of the following:

1. Exposed and Decorative CMUs.
2. Pre-faced CMUs.
3. Pigmented and colored-aggregate mortar.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

C. Insulated CMUs: Where indicated, units shall contain rigid, specially shaped, molded-polystyrene insulation units complying with ASTM C578, Type I, designed for installing in cores of masonry units.

D. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa) or as directed.
2. Density Classification: Normal weight unless otherwise indicated.

E. Concrete Building Brick: ASTM C55.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa) or as directed.
2. Density Classification: Normal weight.

F. Decorative CMUs: ASTM C90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa) or as directed.
2. Density Classification: Normal weight.
3. Pattern and Texture:

   a. Standard pattern, ground-face finish.
   b. Standard pattern, split-face finish.
   c. Standard pattern, split-ribbed finish.
   d. Scored vertically, standard finish.

G. Pre-faced CMUs: Lightweight hollow or solid concrete units complying with ASTM C90, with manufacturer's standard smooth resinous facing complying with ASTM C744.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa) or as directed.
2. Size: Manufactured with pre-faced surfaces having 1/16-inch- (1.5-mm-) wide returns of facing to create 1/4-inch- (6.5-mm-) wide mortar joints.

2.3 CONCRETE LINTELS

A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

G. Aggregate for Mortar: ASTM C144.

1. White-Mortar Aggregates: Natural white sand or crushed white stone.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

K. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch (3.77-mm) or 0.187-inch (4.76-mm) diameter as directed.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) or 0.187-inch (4.76-mm) diameter as directed.
5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
6. Provide in lengths of not less than 10 feet (3 m).

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire.
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

D. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M or Epoxy coating 0.020 inch (0.51 mm) thick as directed.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.

5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
6. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm).

3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.76 mm).

4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch (1.0 mm) thick.

C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M or Type S.
2. For reinforced masonry, use Type S Type N.
3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Decorative CMUs.
b. Pre-faced CMUs.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

a. Decorative CMUs.
b. Pre-faced CMUs.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.

3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

F. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-CELL FILL

A. Pour loose-fill insulation or lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet (6 m).

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 28 days.

3.11 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.12 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.13 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 042300 - GLASS UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass block set in mortar.
2. Glass block set in silicone sealant.
3. Glass block set in glass-block grid systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Glass-block units, glass-block grid material, and joint materials involving color selection.

PART 2 - PRODUCTS

2.1 FIRE-RATED GLASS UNIT MASONRY

A. Assemblies shall be listed by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 257.

2.2 GLASS BLOCK

A. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.
1. Glass Color: As directed.
2. Pattern: Smooth, undistorted inner and outer faces.
3. Pattern: Wavy, light-diffusive design on inner faces, and smooth outer faces.
4. Pattern: Fluted, light-diffusive design, horizontal on one inner face, vertical on other, and smooth outer faces.
5. Pattern: Linear prismatic design, horizontal on one inner face, vertical on other, and smooth outer faces.
6. Pattern: Prismatic pyramid, light-diffusive design on inner faces, and smooth outer faces.
7. Pattern: As indicated by manufacturer's designation.
8. Pattern: Manufacturer's standard decorative pattern to match Architect's sample.
9. Pattern: As selected by Architect from manufacturer's full range.
10. Edge-Coating Color: As directed.
11. Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.

12. Thick-Faced Block: Units with faces at least 3/4 inch (19 mm) thick.

B. Solid Glass Block: Colorless, transparent, solid glass blocks with smooth or stippled faces as directed and manufacturer's standard edge coating .

2.3 GLASS-BLOCK GRID SYSTEMS

A. General: Aluminum extrusions complying with ASTM B221 (ASTM B221M), Alloy 6063-T6 or Alloy 6463-T6, forming a grid system and frame designed for application indicated.

B. Window and Wall System: Aluminum T-bar grid with tubular frame and vinyl glass-block boots.

1. Finish: As selected by Architect from manufacturer's full range.
2. Finish: Custom-color, polyester powder-coat finish; complying with AAMA 2604 and matching Architect's sample.
3. Glass-Block Size: 7-3/4 inches (197 mm) square by 3-1/8 inches (79 mm) thick.
4. Provide aluminum exterior frame covers with vinyl thermal break.
5. Provide aluminum trim and closures as indicated.

C. Sealant: Product recommended by glass-block grid system manufacturer.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.

1. Where joints are indicated to be raked out and pointed, gray cement may be used for setting mortar.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

G. Aggregate: ASTM C144, with 100 percent passing No. 8 (2.36-mm) sieve.

1. For pointing mortar and joints narrower than 1/4 inch (6 mm), use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or crushed white stone.
3. Colored Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Water-Repellent Admixture: Dry mixture of stearates, water-reducing agents, and fine aggregates intended to reduce capillarity in mortar.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

I. Water-Repellent Admixture: Liquid polymeric water-repellent mortar admixture that does not reduce flexural bond strength of mortar.

J. Water: Potable.

2.5 GLASS UNIT MASONRY ACCESSORIES

A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A951/A951M in straight lengths of not less than 10 feet (3 m), and as follows:

1. Interior Walls: Hot-dip galvanized, carbon-steel wire.
2. Exterior Walls: Hot-dip galvanized, carbon-steel wire.
3. Wire Size: W1.7 or 0.148-inch (3.8-mm) diameter.
4. Width: 2 inches (50 mm).
5. Spacing of Cross Rods: Not more than 16 inches (407 mm) apart.

B. Panel Anchors: Glass-block manufacturer's standard perforated steel strips, 0.0359 inch (0.9 mm) by 1-3/4 inches (44 mm) wide by 24 inches (600 mm) long, hot-dip galvanized after fabrication to comply with ASTM A153/A153M.

C. Mortarless Installation System: System of aluminum or plastic perimeter framing, anchors, and spacers designed for installing glass block with sealant-filled joints.

D. Fasteners, General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners at exterior walls and zinc-plated fasteners with coating complying with ASTM B633, Class Fe/Zn 5, at interior walls. Select fasteners for type, grade, and class required.

E. Asphalt Emulsion: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M or ASTM D1227.

F. Mineral-Fiber Expansion Strips: Comply with requirements of fire-rated assembly listing and glass-block manufacturer.

G. Plastic-Foam Expansion Strips: Polyethylene foam complying with requirements of glass-block manufacturer; 3/8 inch (9 mm) thick by 3-1/2 inches (89 mm) wide.

H. Sealants: Manufacturer's standard elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants."

I. Sealant Accessories: Provide sealant accessories, including primers, bond-breaker tape, and cylindrical sealant backing, that comply with applicable requirements in Section 079200 "Joint Sealants."

2.6 MORTAR MIXES

A. General: Do not use admixtures unless otherwise indicated.

1. For mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
2. Limit cementitious materials in mortar to portland cement and lime.

B. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C270, Proportion Specification for Type S mortar.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

PART 3 - EXECUTION

3.1 INSTALLING GLASS BLOCK WITH MORTAR

A. Apply a heavy coat of asphalt emulsion to sill and adhere expansion strips to jambs and heads with asphalt emulsion. Allow asphalt emulsion to dry before placing mortar. Trim expansion strips to width required to fit glass block and to full lengths of heads and jambs.

B. Set glass block with completely filled bed and head joints, with no furrowing, accurately spaced and coordinated with other construction. Maintain 3/8-inch (10-mm) exposed joint widths unless otherwise indicated.

C. Install panel reinforcement in horizontal joints at spacing indicated and continuously from end to end of panels; comply with the following requirements:

1. Vertical Spacing of Panel Reinforcement for Exterior Panels: Every other course but not more than 16 inches (407 mm) o.c., starting with first course above sill.
2. Vertical Spacing of Panel Reinforcement for Interior Panels: Not more than 16 inches (407 mm) o.c.
3. Do not bridge expansion joints with panel reinforcement.
4. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
5. Lap panel reinforcement not less than 6 inches (150 mm) if more than one length is necessary.

D. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least 12 inches (300 mm) into joints, and bend within expansion joints at edges of panels and across the head. Attach panel anchors as follows:

E. Use plastic spacers or temporary wedges in mortar joints to produce uniform joint widths and to prevent mortar from being squeezed out of joints.

F. Keep expansion joints free of mortar.

G. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less than joint width.

1. Point joints at both faces of exterior panels with mortar.
2. Point joints at both faces of exterior panels with sealant.
3. Point joints at both faces of exterior and interior panels with sealant.

H. Point joints with mortar by filling raked joints and voids. Place and compact pointing mortar in layers not more than 3/8 inch (10 mm) thick. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

1. Tool exposed joints slightly concave when pointing mortar is thumbprint hard. Use a smooth plastic jointer larger than joint width.

I. Point joints by filling with sealant to comply with requirements in Section 079200 "Joint Sealants."

J. Install sealant at jambs, heads, mullions, and other locations indicated. Prepare joints, including installation of primer and bond-breaker tape or cylindrical sealant backing, and apply elastomeric sealants to comply with requirements in Section 079200 "Joint Sealants."

3.2 INSTALLING GLASS BLOCK WITH SEALANT

A. General: Install mortarless glass-block systems according to manufacturer's written instructions.

1. Fasten frames and anchors or clips securely to surrounding construction.
2. Shim starting track as needed to make it level.
3. Adhere glass block to starting track and spacers with silicone sealant.

B. After glass blocks are installed, apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.

3.3 GLASS-BLOCK GRID SYSTEM INSTALLATION

A. General: Install glass-block grid systems according to manufacturer's written instructions.

B. Window and Wall System Installation: Assemble grid system, apply continuous sealant bead to back of window Z-bar, place in position, adjust as needed to make grid level and plumb, and fasten to substrate.

1. Insert glass blocks into vinyl glass-block boots and carefully insert into grid from exterior side. Install blocks firmly against T-bars without deforming boots.
2. Apply sealant to completely fill channel around each glass block, and tool flush with exterior surface. Remove excess sealant and smears.

3.4 CLEANING

A. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

END OF SECTION 042300

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay face brick.
2. Concrete face brick.

B. Products Installed but Not Furnished under This Section:

1. Steel lintels in masonry veneer.
2. Steel shelf angles for supporting masonry veneer.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type and color of brick and colored mortar.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product.

1.4 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

2.2 BRICK

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).
1. Grade SW, Grade MW or SW as directed.
2. Type FBX or Type HBX as directed.
3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67.
4. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
5. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
6. Size (Actual Dimensions): 3-1/2 inches (89 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 inches (190 mm) long or 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
7. Color and Texture: As selected.

2.3 CONCRETE BRICK

A. Integral Water Repellent: Provide units made with integral water repellent.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength.

B. Concrete Face Brick: ASTM C1634.
1. ensity Classification: Normal weight.
2. Size (Actual Dimensions: As directed.

3. Texture: As directed.

4. Colors: As selected..

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

2. Colored Masonry Cement:

G. Aggregate for Mortar: ASTM C144.

1. White-Mortar Aggregates: Natural white sand or crushed white stone.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete bricks containing integral water repellent from same manufacturer.

J. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) or 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- (1.52-mm-) thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire.
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch- (1.52-mm-) thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Fabricate wire connector sections from 0.187-inch- (4.76-mm-) or 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized, carbon-steel wire.
5. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with a projecting vertical tab having a slotted hole for inserting wire tie.

7. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.

8. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 9 inches (229 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.

9. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.

10. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.

11. Seismic Masonry-Veneer Anchors: Connector section and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having slotted holes for inserting vertical leg of connector section. Connector section consists of a rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire.

12. Seismic Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie. Wire tie has sheet metal clip welded to it with integral tabs designed to engage continuous wire.

13. Seismic Masonry-Veneer Anchors: Connector section and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting connector section. Connector section consists of a triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire.

14. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.

2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm) .

3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.76 mm).

4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch (1.02 mm) thick.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

3. Aluminum Weep Hole/Vent: Units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel, with louvers stamped in web and with a top flap to keep mortar out of the head joint; factory primed and painted before installation to comply with Section 099113 "Exterior Painting" in color selected by Architect.

4. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Configuration: Provide one of the following:

      a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
      b. Strips, not less than 3/4 inch (19 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
      c. Sheets or strips, full depth of cavity and installed to full height of cavity.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored aggregate mortar for exposed mortar joints.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

B. Provide not less than 2 inches (50 mm) of airspace between back of masonry veneer and face of sheathing or insulation.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.7 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/vent products or open-head joints to form weep holes.
2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.8 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

3.9 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.10 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 044200 - EXTERIOR STONE CLADDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone panels set with individual anchors.
2. Stone panels mechanically anchored on steel trusses.
3. Stone panels mechanically anchored on steel strongback frames.
4. Stone panels mechanically anchored on steel stud frames.
5. Stone panels set in architectural precast concrete.
6. Stone panels glazed into aluminum curtain-wall framing system.
7. Stone trim units, including bands, copings, sills, jambs and soffits.
8. Stone units with carving or inscriptions.

B. Related Requirements:

1. Section 034500 "Precast Architectural Concrete" for casting stone panels in architectural precast concrete units.
2. Section 084413 "Glazed Aluminum Curtain Walls" for installing stone panels in aluminum curtain-wall systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.

1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
2. Show locations and details of anchors and backup structure.
3. Show direction of veining, grain, or other directional pattern.

D. Stone Samples: Sets for each variety, color, and finish of stone required; not less than 12 inches (300 mm) square.

E. Colored Pointing Mortar Samples: For each color required.

F. Sealant Samples: For each type and color of joint sealant required.

G. Delegated-Design Submittal: For stone cladding assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports:

1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three or five years, as directed.

B. Preconstruction test reports.

C. Source quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical exterior wall area not less than 72 inches (1800 mm) long by 48 inches (1200 mm) high or not less than 15 feet (4.5 m) long by 10 feet (3 m) high, as directed.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Stone Testing Service: Owner will engage or engage a qualified testing agency to perform preconstruction testing, as directed.

1. Furnish test specimens that are representative of materials proposed for incorporation into the Work.
2. Physical Property Tests: For each stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
3. Flexural Strength Tests: For each combination of stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested according to ASTM C880/C880M, in both wet and dry conditions.
4. Anchorage Tests: For each combination of stone variety, orientation of cut, finish, and anchor type proposed for use on Project, tested according to ASTM C1354/C1354M.

1.6 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone cladding assembly.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.

1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.

C. Structural Performance: Stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: As indicated.
2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.

D. Seismic Performance: Stone cladding assembly shall withstand the effects of earthquake motions determined according to ASCE/SEI 7, as directed.

1. Component Importance Factor: 1.5 or 1.0, as directed.

E. Safety Factors for Stone: Design stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors or as directed:

1. Safety Factor for Granite: 3.
2. Safety Factor for Oolitic Limestone: 8.
3. Safety Factor for Dolomitic Limestone: 6.
4. Safety Factor for Marble: 5.
5. Safety Factor for Quartz-Based Stone: 6.
6. Safety Factor for Serpentine: 6.
7. Safety Factor for Slate: 5.
8. Safety Factor for Travertine: 8.

2.2 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, Thermal or Match Architect's sample.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Classification: I Low-Density, II Medium-Density or II Medium-Density except as follows: absorption, 5 percent by weight maximum; density, 150 lb/cu. ft. (2400 kg/cu. m) minimum; compressive strength, 8000 psi (55 MPa) minimum; and modulus of rupture 800 psi (5.5 MPa) minimum or III High-Density.

B. Description: Dolomitic, Oolitic or Shell limestone.

C. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert in separate subparagraphs, names of varieties and producers, distributors, or importers.

D. Varieties and Sources: Limestone quarried locations.

1. Limestone Grade and Color: Select, buff, Select, gray, Standard, buff, Standard, gray, Rustic, buff, Rustic, gray or Variegated, according to grade and color classification established by owner.

E. Finish: Smooth finish, Sand rubbed, Machine tooled, four bats per 1 inch (25 mm), Machine tooled, six bats per 1 inch (25 mm), Machine tooled, eight bats per 1 inch (25 mm), as indicated or match Architect's sample.

F. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.4 MARBLE

A. Material Standard: Comply with ASTM C503/C503M, Classification I Calcite, Classification II Dolomite or Group A.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers.

C. Finish: Polished, Honed or as indicated.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.5 QUARTZ-BASED STONE

A. Material Standard: Comply with ASTM C616/C616M, Classification I Sandstone, Classification II Quartzitic Sandstone or Classification III Quartzite except for minimum free silica content.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers.

C. Finish: Sand rubbed, Natural cleft, Thermal or as indicated.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.6 SERPENTINE

A. Material Standard: Comply with ASTM C1526, Classification I Exterior.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers.

C. Finish: Polished, Honed or as indicated.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.7 SLATE

A. Material Standard: Comply with ASTM C629/C629M, Classification I Exterior.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers.

C. Finish: Honed, Sand rubbed, Natural cleft or as indicated.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.8 TRAVERTINE

A. Material Standard: Comply with ASTM C1527/C1527M, Classification I Exterior.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

1. Insert, in separate subparagraphs, names of varieties and producers, distributors, or importers.

C. Cut: Vein or Fleuri.

1. Orientation of Veining: Horizontal, Vertical or as indicated.

D. Filling: Fill pores on faces of stone with cementitious filler of color selected by Architect.

E. Finish: Polished, Honed or as indicated.

F. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.9 FRAMING FOR BACKUP STRUCTURE

A. Steel Trusses, Strongback Frames and Miscellaneous Steel Framing: For framing members in contact with stone, fabricate from same material and finish specified for anchors. For framing members not in contact with stone, comply with requirements indicated below:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M or ASTM A992/A992M, minimum thickness of 3/16 inch (5 mm).
2. Steel Tubing: ASTM A500/A500M or ASTM A513/A513M, minimum thickness of 3/16 inch (5 mm).
3. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4, made from galvanized steel complying with ASTM A653/A653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating, and not less than 0.108-inch (2.74-mm) nominal thickness or steel sheet complying with ASTM A1008/A1008M, structural steel, Grade 33 (Grade 230), not less than 0.105-inch (2.66-mm) nominal thickness, hot-dip galvanized after fabrication to comply with ASTM A123/A123M.

B. Steel Stud Frames: Galvanized-steel wall framing complying with Section 054000 "Cold-Formed Metal Framing."

1. Secondary Weather Barrier (Sheathing): Galvanized-steel sheet complying with ASTM A653/A653M, commercial steel, coating designation G90 (Z275).

2.10 ANCHORS AND FASTENERS

A. Fabricate anchors including shelf angles from stainless steel, ASTM A240/A240M or ASTM A666, Type 304 or Type 316, as directed; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, Type 304 or Type 316, as directed.

B. Fabricate shelf angles for limestone from hot-dip galvanized steel, ASTM A36/A36M for materials and ASTM A123/A123M for galvanizing.

C. Cast-in-Place Concrete Inserts: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel, with capability to sustain, without failure, a load equal to 4 times the loads imposed as

determined by testing per ASTM E488/E488M, conducted by a qualified independent testing agency. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

D. Postinstalled Anchor Bolts for Concrete and Masonry: Chemical anchors, torque-controlled expansion anchors or undercut anchors made from stainless-steel components complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E488/E488M, conducted by a qualified independent testing agency.

E. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. For stainless steel, use annealed stainless-steel bolts, nuts, and washers; for bolts, ASTM F593 (ASTM F738M); and for nuts, ASTM F594 (ASTM F836M), Alloy Group 1 (A1) or Group 2 (A4).
2. For galvanized-steel shelf angles and backup structure, use carbon-steel bolts, nuts, and washers; for bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); for nuts, ASTM A563 (ASTM A563M), Grade A; and for washers, ASTM F436 (ASTM F436M); all hot-dip or mechanically zinc coated.

F. Weld Plates for Installation in Concrete: Comply with Section 055000 "Metal Fabrications."

2.11 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.

1. Low-Alkali Cement: Portland cement for use with limestone shall contain no more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Pigments shall have a record of satisfactory performance in mortar.

D. Aggregate: ASTM C144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, 100 percent shall pass No. 16 (1.18-mm) sieve.

E. Water: Potable.

2.12 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone

on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. Concealed Sheet Metal Flashing: Fabricated from zinc-tin, alloy-coated stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick and complying with Section 076200 "Sheet Metal Flashing and Trim."

C. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

D. Weep and Vent Tubes: Medium-density polyethylene tubing, 1/4-inch (6-mm) OD or Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches (9 by 38 mm), of length required to extend from exterior face of stone to cavity behind.

E. Cellular Plastic Weep Hole/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

F. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

G. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:

1. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, NT; S, NS, 50, NT; S, NS, 100/50, T, NT or M, NS, 50, NT.
2. Joint Sealant: Urethane, S, NS, 25, NT; S, NS, 100/50, T, NT; M, NS, 50, NT; M, NS, 50, T, NT; M, NS, 25, T, NT.
3. Joint Sealant: As directed.
4. Joint-Sealant Colors: As indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from manufacturer's full range of colors or Match color of stone.

H. Preformed Joint Seals: Preformed silicone or foam joint seals that comply with applicable requirements in Section 079100 "Preformed Joint Seals" and do not stain stone.

I. Sealant for Filling Kerfs: Same sealant used for joints in stone cladding. Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and that do not stain stone:

1. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

2. Urethane, M, NS, 25, T, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.13 STONE FABRICATION

A. Control depth of stone and back check to maintain minimum clearance of 1 inch (25 mm) or 1-1/2 inches (38 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

C. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

D. Finish exposed faces and edges of stone except sawed reveals to comply with requirements indicated for finish and to match approved samples and mockups.

E. Cut stone to produce uniform joints 3/8 inch (10 mm) or 1/2 inch (13 mm) wide and in locations indicated.

F. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

G. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

2.14 FABRICATION OF BACKUP STRUCTURE

A. Fabrication of Steel Trusses, Strongback Frames and Miscellaneous Steel Framing: Fabricate in shop to comply with AISC 303.

B. Fabrication of Steel Stud Frames: Fabricate and assemble by welding to comply with requirements in Section 054000 "Cold-Formed Metal Framing."

2.15 SHOP-PAINTED STEEL FINISHES

A. General: Paint uncoated steel backup structure before delivering to Project site to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel."

B. Surface Preparation: After fabricating steel items, prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Apply one coat of fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#76. After primer has dried, apply one coat of exterior alkyd enamel complying with MPI#96 of a different color than primer.

D. Apply two-coat, high-performance coating system consisting of epoxy zinc-rich primer, complying with MPI#20 and topcoat of high-build epoxy coating, complying with MPI#108.

2.16 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions. Do not use admixtures, unless otherwise indicated.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C270, Proportion Specification, Type S or Type N, as directed for types of mortar indicated below:

1. Set granite with Type S mortar.
2. Set limestone with Type N mortar.
3. Set marble with Type S mortar.
4. Set quartz-based stone with Type S or Type N mortar, as directed
5. Set serpentine with Type S mortar.
6. Set slate with Type S mortar.
7. Set travertine with Type N mortar.
8. Backparge travertine with Type O mortar.

C. Pointing Mortar: Comply with ASTM C270, Proportion Specification, Type S, Type N or Type O for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following, as directed:

1. Pigmented Pointing Mortar: Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Point granite with Type S or Type N mortar.
3. Point limestone with Type N or Type O mortar.
4. Point marble with Type N or Type O mortar.
5. Point quartz-based stone with Type N or Type O mortar.
6. Point serpentine with Type N or Type O mortar.
7. Point slate with Type N mortar.
8. Point travertine with Type N or Type O mortar.

PART 3 - EXECUTION

3.1 INSTALLING BACKUP STRUCTURE

A. Installing Steel Trusses, Strongback Frames and Miscellaneous Steel Framing: Comply with AISC 303 and install to accommodate construction tolerances specified.

1. Maintain erection of backup structure within tolerances in AISC 303.
2. For prefabricated units to which stone has been installed before erection, maintain tolerances of stone faces and edges as specified in "Installation Tolerances" Article.

B. Installing Steel Stud Frames: Install by welding to steel weld-plates anchored in concrete, by welding to structural-steel frame or by bolting to structural-steel frame to comply with requirements in Section 054000 "Cold-Formed Metal Framing", as directed

1. Install steel stud frames level, plumb, and true to line with no variation in plane or alignment exceeding 1/16 inch (1.5 mm) and no variation in position exceeding 1/8 inch (3 mm).

2. For prefabricated frames to which stone has been installed before erection, maintain tolerances of stone faces and edges as specified in "Installation Tolerances" Article.

3.2 SETTING STONE CLADDING, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Coat limestone with dampproofing to extent indicated below:

1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
2. Stone Extending Below Grade: Beds, joints, back surfaces, and face surfaces below grade.

C. Parge back of travertine panels with mortar not less than 3/8 inch (10 mm) thick.

D. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone.

E. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.

F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of mortar and other rigid materials.

G. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

H. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.

1. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm).
2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally.

3.3 SETTING MECHANICALLY ANCHORED STONE CLADDING

A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C1242.

B. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.

C. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.4 SETTING STONE CLADDING WITH MORTAR

A. Set stone in full bed of mortar with head joints filled unless otherwise indicated.

1. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.

B. Embed ends of sills in mortar; leave remainder of joint open until final pointing.

C. Rake out joints for pointing with mortar to depths of not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

D. Point stone joints by placing pointing mortar in layers not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

E. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.

F. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

3.5 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.6 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

E. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.7 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

B. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200

SECTION 044313.13 - ANCHORED STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone masonry anchored to concrete backup.
2. Stone masonry anchored to unit masonry backup.
3. Stone masonry anchored to wood framing and sheathing.
4. Stone masonry anchored to cold-formed metal framing and sheathing.

B. Products Installed but Not Furnished under This Section Include:

1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for concealed flashing, horizontal joint reinforcement and veneer anchors.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals:

C. Samples:

1. For each stone type indicated.
2. For each color of mortar required.

1.3 FIELD CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried.

C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.2 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Classification: I Low Density, II Medium Density, II Medium Density, except as follows: absorption, 5 percent by weight maximum; density, 150 lb/cu. ft. (2400 kg/cu. m) minimum; compressive strength, 8000 psi (55 MPa) minimum; and modulus of rupture 800 psi (5.5 MPa) minimum or III High Density.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.3 QUARTZ-BASED STONE

A. Material Standard: Comply with ASTM C616/C616M, Classification I Sandstone, Classification II Quartzitic Sandstone or Classification III Quartzite.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.4 OTHER STONE

A. Material Standards:

1. Maximum Absorption per ASTM C97/C97M: 7.5 or 3 percent.
2. Minimum Compressive Strength per ASTM C170/C170M: 4000 psi (28 MPa) or 7500 psi (52 MPa).

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.

E. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.

F. Colored Masonry Cement Mix: Packaged blend of masonry cement and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate: ASTM C144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

H. Water: Potable.

2.6 VENEER ANCHORS

A. Materials:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M; with ASTM A153/A153M, Class B-2.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304 or Type 316.
3. Hot-Dip Galvanized-Steel Sheet: ASTM A1008/A1008M, cold-rolled, carbon-steel sheet, hot-dip galvanized after fabrication to comply with ASTM A153/A153M, Class B-2.
4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 or Type 316.

B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches (38 mm), through stone masonry and with at least a 5/8-inch (16-mm) cover on exterior face.

C. Wire Veneer Anchors: Wire ties formed from W1.7 or 0.148-inch (3.8-mm) diameter, hot-dip galvanized or stainless steel wire.

D. Corrugated-Metal Veneer Anchors: Not less than 0.030-inch (0.76-mm) or 0.060-inch (1.52-mm) thick by 7/8-inch (22-mm) wide hot-dip galvanized or stainless steel sheet with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 13 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm).

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch (1.90-mm) thick steel sheet, galvanized after fabrication, 0.105-inch (2.66-mm) thick steel sheet, galvanized after fabrication, 0.078-inch (1.98-mm) thick, stainless steel sheet or 0.109-inch (2.78-mm) thick, stainless steel sheet.
3. Fabricate wire ties from 0.187-inch (4.76-mm) or 0.25-inch (6.35-mm) diameter, hot-dip galvanized-steel or stainless steel wire unless otherwise indicated.
4. Fabricate wire connector sections from 0.187-inch (4.76-mm) or 0.25-inch (6.35-mm)] diameter, hot-dip galvanized-steel or stainless steel wire.
5. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.

F. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:

1. Anchor Section: Rib-stiffened, sheet metal plate with screw holes in top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (75 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit veneer anchor section.

G. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:

1. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 9 inches (225 mm) long, with screw holes in top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.

H. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:

1. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes in top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.

I. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:

1. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes in top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (150 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.

J. Adjustable, Seismic Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in stone masonry mortar joint, complying with the following requirements:

1. Anchor Section: Rib-stiffened, sheet metal plate with screw holes in top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (75 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section. Size wire tie to extend at least 1-1/2 inches (38 mm) into stone masonry but with at least a 5/8-inch (16-mm) cover on exterior face.
2. Connector Section: Sheet metal clip welded to wire tie with integral tabs designed to engage continuous wire.
3. Continuous Wire: 0.188-inch (4.8-mm) diameter, hot-dip galvanized or stainless steel wire.

K. Adjustable, Seismic Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in stone masonry mortar joint, complying with the following requirements:

1. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes in top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (150 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.
2. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire.
3. Continuous Wire: 0.188-inch (4.8-mm) diameter, hot-dip galvanized or stainless steel wire.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing**,** where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch (0.4 mm) thick.
2. Copper: ASTM B370, Temper H00 or H01, cold-rolled copper sheet, 10-oz./sq. ft. (3-kg/sq. m) weight or 0.0135 inch (0.34 mm) thick for fully concealed flashing; 16-oz./sq. ft. (5-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick elsewhere.

3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
6. Fabricate metal expansion-joint strips from stainless steel or copper to shapes indicated.

B. Flexible Flashing: For flashing unexposed to the exterior, use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) or 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded with asphalt between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive, rubberized-asphalt compound, bonded to a high-density, cross-laminated, polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm) or 0.040 inch (1.0 mm).

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.

C. Asphalt Dampproofing: Cut-back asphalt complying with ASTM D4479/D4479M, Type I or asphalt emulsion complying with ASTM D1227, Type III or Type IV.

D. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, in length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity behind stone masonry. Use only for weeps.
2. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch (10-mm) OD by thickness of stone masonry.
3. Mesh Weep Holes/Vents: Free-draining mesh; made from polyethylene strands, full width of head joint and 2 inches (50 mm) high by thickness of stone masonry; in color selected from manufacturer's standard.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:

    a. Strips, full depth of cavity and 10 inches (250 mm) wide, with dovetail-shaped notches 7 inches (175 mm) deep that prevent mesh from being clogged with mortar droppings.
    b. Strips, not less than 3/4 inch (19 mm) or 1-1/2 inches (38 mm)] thick and 10 inches (250 mm) wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
    c. Sheets or strips full depth of cavity and installed to full height of cavity.
    d. Sheets or strips not less than 3/4 inch (19 mm) or 1 inch (25 mm) thick and installed to full height of cavity with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from being clogged with mortar.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.10 FABRICATION

A. Cut, Split or Select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.

    1. Shape stone specified to be laid in three-course, random range ashlar pattern with sawed or split beds.

B. Thickness of Stone: Provide thickness indicated, but not less than the following:

    1. Thickness: 4 inches (100 mm) plus or minus 1/4 inch (6 mm) or 1/2 inch (13 mm). Thickness does not include projection of pitched faces.

C. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples.

    1. Finish: Split face, Rock face (pitched face), Natural cleft, Mixed split face and seam face, Mixed split face, seam face, and rock face (pitched face), Smooth or Sand rubbed, as indicated.
    2. Finish for Sills: Smooth, Sand rubbed, Split face with sand-rubbed washes, Rock face (pitched face) with sand-rubbed washes or Rock face (pitched face) with tooled (boasted) washes.
    3. Finish for Lintels: Smooth, Sand rubbed, Split face or Rock face (pitched face).
    4. Finish for Copings: Smooth, Sand rubbed, Split face or Rock face (pitched face), front and back; sand-rubbed top, Rock face (pitched face), front and back; tooled (boasted) top.

        a. Finish exposed ends of copings same as front and back faces.

2.11 MORTAR MIXES

A. General: Do not use admixtures unless otherwise indicated.

1. Do not use calcium chloride.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Mortar for Stone Masonry: Comply with ASTM C270, Proportion Specification.

1. Mortar for Setting Stone: Type S or Type N.
2. Mortar for Pointing Stone: Type N or Type O.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement product.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.

PART 3 - EXECUTION

3.1 PREPARATION

A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.

B. Coat concrete and unit masonry backup with asphalt dampproofing.

3.2 SETTING STONE MASONRY

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones in range ashlar pattern with course heights as indicated, uniform or random lengths, and uniform joint widths, with offset between vertical joints as indicated.

D. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.

E. Arrange stones in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.

F. Arrange stones in coursed or uncoursed rubble pattern with joint widths within tolerances indicated. Insert small stones into spaces between larger stones as needed to produce joints as uniform in width as practical.

G. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

H. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch (6 mm) or 3/8 inch (10 mm) at narrowest points or more than 3/8 inch (10 mm), 1/2 inch (13 mm), 5/8 inch (16 mm), 1 inch (25 mm) or 1-1/2 inches (38 mm), as directed at widest points.

I. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.
2. Sealant joints are specified in Section 079200 "Joint Sealants."

J. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least 8 inches (200 mm), 12 inches (300 mm) or 16 inches (400 mm), as directed behind weather barrier.
2. At multiwythe masonry walls, including cavity walls, extend flashing through stone masonry, turned up a minimum of 4 inches (100 mm), 8 inches (200 mm), 12 inches (300 mm) or 16 inches (400 mm) as directed, and extend into or through inner wythe to comply with requirements in Section 042000 "Unit Masonry."
3. At concrete backing, extend flashing through stone masonry, turned up a minimum of 4 inches (100 mm), 6 inches (150 mm), 8 inches (200 mm) or 12 inches (300 mm) as directed, and insert in reglet. Reglets are specified in Section 076200 "Sheet Metal Flashing and Trim."
4. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches (150 mm) into masonry at each end.
5. At sills, extend flashing not less than 4 inches (100 mm) at ends.
6. At ends of head and sill flashing, turn up not less than 2 inches (50 mm) to form end dams.
7. Extend sheet metal flashing 1/2 inch (13 mm) beyond masonry face at exterior, and turn flashing down to form a drip.
8. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face and adhere flexible flashing to top of metal drip edge.
9. Install metal flashing termination beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face and adhere flexible flashing to top of metal flashing termination.

10. Cut flexible flashing flush with wall face after completing masonry wall construction.

K. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.

1. Use wicking material, round plastic tubing, mesh weep holes/vents or open head joints to form weep holes.
2. Use wicking material to form weep holes above flashing in stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 16 inches (400 mm) or 24 inches (600 mm) o.c., as directed.
4. Trim wicking material used in weep holes flush with exterior wall face after mortar has set.
5. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

L. Install vents in head joints at top of each continuous cavity at spacing indicated. Use [round plastic tubing] [mesh weep holes/vents] [or] [open head joints] to form vents.

M. Coat limestone with cementitious dampproofing as follows:

1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.

3.3 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

3.4 INSTALLATION OF ANCHORED STONE MASONRY

A. Anchor stone masonry to concrete with corrugated-metal veneer anchors unless otherwise indicated. Secure anchors by inserting dovetailed ends into dovetail slots in concrete.

B. Anchor stone masonry to unit masonry with corrugated-metal or individual wire veneer anchors unless otherwise indicated. Embed anchors in unit masonry mortar joints or grouted cells at a distance of at least one-half of unit masonry thickness.

C. Anchor stone masonry to unit masonry with wire anchors unless otherwise indicated. Connect anchors to masonry joint reinforcement by inserting pintles into eyes of masonry joint reinforcement projecting from unit masonry.

D. Anchor stone masonry to unit masonry with wire anchors unless otherwise indicated. Connect anchors to masonry joint reinforcement with vertical rods inserted through anchors and through eyes of masonry joint reinforcement projecting from unit masonry.

E. Anchor stone masonry to stud framing with adjustable, screw-attached or seismic veneer anchors unless otherwise indicated. Fasten anchors through sheathing to framing with two screws.

F. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 1-1/2 inches (38 mm), through stone masonry and with at least a 5/8-inch (16-mm) cover on exterior face.

1. Install continuous wire reinforcement in horizontal joints and attach to seismic veneer anchors as stone is set.

G. Space anchors to provide not less than one anchor per 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).

H. Space anchors not more than 16 inches (400 mm) o.c. vertically and 24 inches (600 mm) o.c. horizontally. Install additional anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).

I. Space anchors not more than 18 inches (450 mm) o.c. vertically and 32 inches (800 mm) o.c. horizontally, with not less than one anchor per 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).

J. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.

K. Fill collar joint or space between back of stone masonry and weather-resistant sheathing paper with mortar as stone is set.

L. Provide 1-inch (25-mm) or 2-inch (50-mm) cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.

1. Slope beds toward cavity to minimize mortar protrusions into cavity.
2. Do not attempt to trowel or remove mortar fins protruding into cavity.

M. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm) or 3/4 inch (19 mm), as directed, before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.5 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: Concave, Smooth, flat face slightly below edges of stone, Smooth, flat face recessed 1/4 inch (6 mm) below edges of stone (raked joint) or Flush, with a 3/8-inch (10-mm) half-round raised bead in middle of joint, as indicated.

3.6 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.7 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

END OF SECTION 044313.13

SECTION 044313.16 - ADHERED STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone masonry adhered to concrete backup.
2. Stone masonry adhered to unit masonry backup.
3. Stone masonry adhered to wood framing and sheathing.
4. Stone masonry adhered to cold-formed metal framing and sheathing.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for concealed flashing.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals: As directed.

C. Samples:

1. For each stone type indicated.
2. For each color of mortar required.

1.3 FIELD CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried.

C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.2 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Classification: I Low Density, II Medium Density, II Medium Density, except as follows: absorption, 5 percent by weight maximum; density, 150 lb/cu. ft. (2400 kg/cu. m) minimum; compressive strength, 8000 psi (55 MPa) minimum; and modulus of rupture 800 psi (5.5 MPa) minimum or III High Density.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.3 QUARTZ-BASED STONE

A. Material Standard: Comply with ASTM C616/C616M, Classification I Sandstone, Classification II Quartzitic Sandstone or Classification III Quartzite, except for minimum free silica content.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.4 OTHER STONE

A. Material Standards:

1. Maximum Absorption according to ASTM C97/C97M: 7.5, 3 percent or as directed.
2. Minimum Compressive Strength according to ASTM C170/C170M: 4000 psi (28 MPa), 7500 psi (52 MPa) or as directed.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.

E. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.

F. Colored Masonry Cement Mix: Packaged blend of masonry cement and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate: ASTM C144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. White Aggregates: Natural white sand or ground white stone.
3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

H. Latex Additive: Manufacturer's standard, Acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

I. Water: Potable.

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch (0.4 mm) thick.
2. Copper: ASTM B370, Temper H00 or H01, cold-rolled copper sheet, 10-oz./sq. ft. (3-kg/sq. m) weight or 0.0135 inch (0.34 mm) thick for fully concealed flashing; 16-oz./sq. ft. (5-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick elsewhere.
3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
6. Fabricate metal expansion-joint strips from stainless steel or copper to shapes indicated.

B. Flexible Flashing: For flashing unexposed to the exterior, use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) or 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded with asphalt between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive, rubberized-asphalt compound, bonded to a high-density, cross-laminated, polyethylene film to produce an overall thickness of not less than 0.030 inch (0.76 mm) or 0.040 inch (1.0 mm).

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.

B. Weep Products: Use one of the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter.
2. Mesh Weep Holes: Free-draining mesh; made from polyethylene strands, full width of head joint and 2 inches (50 mm) high by thickness of stone masonry; in color selected from manufacturer's standard.

C. Expanded Metal Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m), self-furring, diamond-mesh lath complying with ASTM C847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G60 (Z180).

D. Welded-Wire Lath: ASTM C933, fabricated into 2-by-2-inch (50-by-50-mm) mesh with minimum 0.0625-inch- (1.6-mm-) diameter, galvanized-steel wire.

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.9 FABRICATION

A. Cut, Split or Select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.

1. Shape stone specified to be laid in three-course, random range ashlar pattern with sawed or split beds.

B. Gage backs of stones for adhered veneer if more than 81 sq. in. (522 sq. cm) in area.

C. Thickness of Stone: Provide thickness indicated, but not less than the following:

1. Thickness: 1 inch (25 mm) plus or minus 1/8 inch (3 mm) or 1/4 inch (6 mm).

D. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples and mockups.

1. Finish: Split face, Rock face (pitched face), Natural cleft, Mixed split face and seam face, Mixed split face or seam face, and rock face (pitched face), Smooth or Sand rubbed as indicated.
2. Finish for Sills: Smooth, Sand rubbed, Split face with sand-rubbed washes, Rock face (pitched face) with sand-rubbed washes or Rock face (pitched face) with tooled (boasted) washes.
3. Finish for Lintels: Smooth, Sand rubbed, Split face or Rock face (pitched face).
4. Finish for Copings: Smooth, Sand rubbed, Split face or Rock face (pitched face), front and back; sand-rubbed top, Rock face (pitched face), front and back; tooled (boasted) top, as directed.

    a. Finish exposed ends of copings same as front and back faces.

2.10 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Mortar for Stone Masonry: Comply with ASTM C270, Proportion Specification.

1. Mortar for Setting Stone: Type S or Type N.
2. Mortar for Pointing Stone: Type N or Type O.

C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

D. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.

1. For latex-modified portland cement, setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.

E. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.

F. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, 7 parts loose damp sand, and enough water to produce a workable consistency.

G. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.

PART 3 - EXECUTION

3.1 SETTING STONE MASONRY

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones in range ashlar pattern with course heights as indicated, uniform or random lengths, and uniform joint widths, with offset between vertical joints as indicated.

D. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.

E. Arrange stones in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.

F. Arrange stones in polygonal (mosaic) pattern with uniform joint widths.

G. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

H. Maintain uniform joint widths, except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch (6 mm) or 3/8 inch (10 mm) at narrowest points or more than 3/8 inch (10 mm), 1/2 inch (13 mm), 5/8 inch (16 mm), 1 inch (25 mm) or 1-1/2 inches (38 mm) at widest points.

I. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.

2. Sealant joints are specified in Section 079200 "Joint Sealants."

J. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least 8 inches (200 mm), 12 inches (300 mm) or 16 inches (400 mm), and behind weather barrier.
2. At multiwythe masonry walls, extend flashing through stone masonry, turned up a minimum of 4 inches (100 mm), 8 inches (200 mm), 12 inches (300 mm) or 16 inches (400 mm), and extend into or through inner wythe to comply with requirements in Section 042000 "Unit Masonry."
3. At concrete backing, extend flashing through stone masonry, turned up a minimum of 4 inches (100 mm), 6 inches (150 mm), 8 inches (200 mm) or 12 inches (300 mm), and insert in reglet. Reglets are specified in Section 076200 "Sheet Metal Flashing and Trim."
4. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches (150 mm) into masonry at each end.
5. At sills, extend flashing not less than 4 inches (100 mm) at ends.
6. At ends of head and sill flashing, turn up not less than 2 inches (50 mm) to form end dams.
7. Extend sheet metal flashing 1/2 inch (13 mm) beyond masonry face at exterior and turn flashing down to form a drip.
8. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face and adhere flexible flashing to top of metal drip edge.
9. Install metal flashing termination beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch (13 mm) back from exterior wall face and adhere flexible flashing to top of metal flashing termination.
10. Cut flexible flashing flush with wall face after completing masonry wall construction.

K. Coat limestone with cementitious dampproofing as follows:

1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.

L. Place weep holes in joints where moisture may accumulate, including above shelf angles and at flashing.

1. Use wicking material, mesh weep holes or open head joints to form weep holes.
2. Use wicking material to form weep holes above flashing in stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 16 inches (400 mm) or 24 inches (600 mm) o.c.
4. Trim wicking material used in weep holes flush with exterior wall face after mortar has set.

3.2 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For

external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

3.3 INSTALLATION OF ADHERED STONE MASONRY VENEER

A. Install flashing over sheathing and behind building paper or wrap and drainage material by fastening through sheathing into framing.

B. Install lath over building paper or wrap and drainage material by fastening through sheathing into framing to comply with ASTM C1063.

C. Install lath over unit masonry and concrete to comply with ASTM C1063.

D. Install scratch coat over metal lath 3/8 inch (10 mm) thick to comply with ASTM C926.

E. Coat backs of stone units and face of scratch coat or masonry backup with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar, so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units and scratch coat, masonry backup.

F. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm) or 3/4 inch (19 mm) before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.4 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: Concave, Smooth, flat face slightly below edges of stone, Smooth, flat face recessed 1/4 inch (6 mm) below edges of stone (raked joint) or Flush, with a 3/8-inch (10-mm) half-round raised bead in middle of joint or as indicated.

3.5 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.6 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

END OF SECTION 044313.16

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-stone trim.
2. Cast-stone steps.
3. Cast-stone bollards.
4. Cast-stone benches.
5. Cast-stone curbing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast-stone units, include dimensions and finishes.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

D. Samples:

1. For each color and texture of cast stone required.
2. For colored mortar.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364, including test for resistance to freezing and thawing.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute, the Architectural Precast Association or the Precast/Prestressed Concrete Institute for Group A, Category AT.

PART 2 - PRODUCTS

2.1 CAST-STONE UNITS

A. Cast-Stone Units: Comply with ASTM C1364.

1. Units shall be manufactured using the vibrant dry tamp or wet-cast method.
2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C666/C666M, Procedure A, as modified by ASTM C1364.

B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

C. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
b. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
c. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
d. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.

D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

E. Colors and Textures: Match Architect's samples, Match existing units or as selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666 or [steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M.

B. Dowels: 1/2-inch- (12-mm) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666 or steel complying with ASTM A36/A36M and hot-dip galvanized to comply with ASTM A123/A123M.

C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by

cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.3 MORTAR

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

1. For setting mortar, use Type S or Type N.
2. For pointing mortar, use Type N or Type O.

B. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

2.4 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C1364.

1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 SETTING CAST STONE IN MORTAR

A. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."

B. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Fill dowel holes and anchor slots with mortar.
2. Fill collar joints solid as units are set.
3. Build concealed flashing into mortar joints as units are set.
4. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
5. Keep joints at shelf angles open to receive sealant.

C. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

D. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.

F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.

G. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.2 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.

B. Fill anchor holes with sealant.

1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

C. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.

D. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 050170.51 - DECORATIVE METAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes decorative metal cleaning as follows:

1. Cleaning metal.
2. Removing paint
3. Removing corrosion.
4. Priming for repainting.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.

1.3 ALLOWANCES

A. Allowances for decorative metal cleaning are specified in Section 012100 "Allowances."

1. Perform decorative metal cleaning under quantity allowances and only as authorized. Authorized work includes work required by Drawings and Specifications and only work as directed in writing by Architect.
2. Notify Architect weekly of extent of work performed that is attributable to quantity allowances.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Preconstruction testing is part of testing and inspecting allowance.

C. Cleaning and removing paint from material is part of prep.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances, estimated quantities.
2. Unit prices apply to authorized additions to and deletions from the Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) and or as directed.

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) and or as directed.

C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) and or as directed.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at and or as directed.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For decorative metal refinishing specialist.

B. Preconstruction Test Reports: For chemical cleaning of and paint removal from decorative metal.

1.9 QUALITY ASSURANCE

A. Decorative Metal Cleaning Specialist Qualifications: A qualified decorative metal cleaning specialist. Cleaning specialist shall be experienced in using mechanical and chemical methods on the types of metal surfaces indicated.

1. Single Specialist: Subject to compliance with requirements, engage the same specialist firm to perform the work of Section 050170.61 "Decorative Metal Repair" Section 050170.63 "Decorative Metal Refinishing" and the work of this Section.

B. Mockups: Prepare mockups of decorative metal cleaning processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous.

1. Cleaning: Prepare an area approximately 2 sq. ft. (0.2 sq. m) as indicated on Drawings and or as directed for each process on each type of metal indicated for treatment.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency or one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on each type of metal.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with decorative metal cleaning only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials, including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.
2. Blasting Abrasive: Pulverized walnut shells, Powdered aluminum silicate and or as directed.
3. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline-Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from metals, and containing no methylene chloride.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming alkaline paste or gel formulation for removing paint from metal, and containing no methylene chloride.

C. Solvent-Type-Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from metals.

D. Low-Odor, Solvent-Type-Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable solvent-type paste, gel, or foamed emulsion formulation for removing paint from metals; and containing no methanol or methylene chloride.

E. Covered, Solvent-Type-Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; and containing no methanol or methylene chloride.

2.3 MISCELLANEOUS MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces; and that will easily come off entirely, including adhesive.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

    a. Remove, alter, or in any way harm the present or future condition of existing surfaces, including surrounding surfaces not in the Contract.
    b. Leave an unintended residue on surfaces.

2.4 FERROUS METAL PRIMERS

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090190.52 "Maintenance Repainting" for finish painting of primed metal.

PART 3 - EXECUTION

3.1 DECORATIVE METAL CLEANING SPECIALIST

A. Decorative Metal Cleaning Specialist Firms: Subject to compliance with requirements, provide decorative metal cleaning by one of the following, firms that may provide decorative metal cleaning include, but are not limited to, the following:

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 DECORATIVE METAL CLEANING, GENERAL

A. Execution of the Work: In cleaning items, disturb them as minimally as possible and as follows:

1. Remove deteriorated coatings and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Clean items in place unless otherwise indicated.

B. Mechanical Coating Removal: Use gentle methods, such as scraping and wire brushing, that will not abrade metal substrate.

C. Repaint: Where indicated, prepare painted decorative metal by cleaning surface, removing less than firmly adhered existing paint, sanding edges smooth, removing existing paint and priming for painting as specified.

3.4 CLEANING

A. General: Use those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

B. Water Cleaning: Clean with cold, hot water applied by low, medium, high-pressure spray. Supplement with natural-fiber or plastic-bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic-bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. As directed rinse with cold or hot water applied by low, medium, high-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure where needed to produce cleaning effect established by mockup.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup of two to three minutes.

4. Nonferrous Metals: Rinse with cold, hot water applied by low, medium, high-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.
6. Repeat cleaning procedure where needed to produce cleaning effect established by mockup. Do not repeat more than once.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray. Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

F. Cleaning by Abrasive Blasting: Clean surfaces to remove dirt, leaving uniform patina intact,] by dry blasting with specified blasting abrasive at pressure and distance from surface indicated below. Rinse with cold-water, low-pressure spray to remove residue. Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

1. Pressure and Distance from Surface: Maximum pressure of 60 psi (415 kPa) 100 psi (690 kPa) 200 psi (1375 kPa) with specified blasting abrasive propelled from a distance of 6 to 12 inches (152 to 305 mm) 12 to 18 inches (305 to 457 mm) from surface.
2. Pressure and Distance from Surface: As established by mockup.

G. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

H. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous metal cleaning.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 PAINT REMOVAL

A. General: Use only those paint-removal methods indicated for each type of decorative metal.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.

2. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

a. Equip units with pressure gages.
b. Unless otherwise indicated, hold spray nozzle at least 6 inches (152 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with cone-shaped spray.
d. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
e. For high-pressure water-spray application, use fan-shaped spray tip that disperses water at an angle of at least 40 degrees.
f. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Alkaline-Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold, hot water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold, hot water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.

8. For spots of remaining paint, apply alkaline-paste paint remover according to "Paint Removal with Alkaline-Paste Paint Remover" Paragraph above.

D. Paint Removal with Solvent-Type-Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold, hot water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

E. Paint Removal with Covered, Solvent-Type-Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold, hot water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove remaining chemicals and paint residue.

3.6 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.7 DECORATIVE METAL CLEANING SCHEDULE

A. Treatment for Decorative Railing DMR-1: Wrought-iron railing and gate.

1. General: Perform work in the shop or in the field.
2. Paint Removal: Alkaline-paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type-paste paint remover, Low-odor, solvent-type-paste paint remover, Covered, solvent-type paint remover.
3. Repairs: As specified in Section 050170.61 "Decorative Metal Repair."

4. Painted Finish: As specified in Section 090190.52 "Maintenance Repainting." And or as directed.

B. Treatment of Decorative Railing DMR-2: Cast-iron balustrade.

1. General: Perform work in the shop or in the field.
2. Paint Removal: Alkaline-paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type-paste paint remover, Low-odor, solvent-type-paste paint remover, Covered, solvent-type-paste paint remover.
3. Rust Removal: Chemical, Mechanical.
4. Repair: As specified in Section 050170.61 "Decorative Metal Repair."
5. Painted Finish: As specified in Section 090190.52 "Maintenance Repainting." and or as directed.

C. Treatment of Decorative Railing DMR-3: Bronze railing with bronze handrail.

1. General: Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning, Chemical cleaning, Abrasive blasting.
3. Repair: As specified in Section 050170.61 "Decorative Metal Repair."
4. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

D. Treatment for Bronze Grille DMG-#: Strip paint and coat grille.

1. General: Perform work in the shop or in the field.
2. Paint Removal: Solvent-type-paste paint remover, Low-odor, solvent-type-paste paint remover, Covered, solvent-type-paste paint remover.
3. Protective Coating: As specified in Section 050170.63 "Decorative Metal Refinishing."

END OF SECTION 050170.51

SECTION 050170.61 - DECORATIVE METAL REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes decorative metal repairs as follows:

1. Repairing metal and replacing damaged and missing components in place.
2. Removing metal for shop repair and replacement of components; reinstalling repaired metal.
3. Installing wood rails supported by or attached to decorative metal railings or brackets.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and extent of repair and replacement work and details of each new metal item and component and its location on the structure.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For structural performance of repaired railings, handrails, and anchors, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Decorative Metal Repair Specialist Qualifications: A qualified decorative metal fabrication and repair specialist. Experience installing and finishing new decorative metalwork is insufficient experience for repairing decorative metal.

B. Mockups: Prepare mockups of decorative metal repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Replacing Cast-Metal Components: Two cast-iron handrail brackets and grilles replaced with exact duplicates.
2. Replacing Cut-Out Metal Items: Two cut-out bronze-plate wall registers replaced with exact duplicates.
3. Repairing Wrought Handrail and Railing: 3 feet (1 m) of wrought-iron handrail and railing. Patch indentations and reconnect fractures by filling, welding, brazing, or applying new metal material.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design post-installed structural anchors.

B. Structural Performance: Railings and handrails, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METAL MATERIALS

A. General: Provide decorative metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.3 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.
2. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.4 FASTENERS

A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting decorative metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.

B. Anchors, General: Use bolt heads of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal anchored.

C. Post-Installed Structural Anchors: Fastener systems; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193 AC58 or AC308 as appropriate for the substrate.

1. Uses: Securing railings and handrails to concrete.
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Post-Installed Nonstructural Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.5 MISCELLANEOUS MATERIALS

A. Wood Rails: Hardwood rails of species and profile matching design reference sample, matching existing or as indicated on Drawings, complying with Section 064013 "Exterior Architectural Woodwork" or Section 064023 "Interior Architectural Woodwork" as directed.

B. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as recommended in writing by producer of metal to be welded or filled and as required for color match, strength, and compatibility in fabricated items.

C. Brazing Rods for Copper-Alloy Components: Type and alloy as recommended in writing by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

D. Brazing Rods for Cast-Iron Components: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for strength and compatibility in fabricated items.

E. Metal-Patching Compound: Two-part, polyester-resin metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

2.6 METAL FABRICATION

A. Fabricate repairs of decorative metal items and components in sizes and profiles to match existing decorative metal, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

C. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

D. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

1. Finish castings to match existing decorative metalwork.
2. Replacement Casting for Handrail Bracket: Duplicate existing handrail bracket on the cast-iron railing of first-floor stairs in the lobby. Make molds from this bracket to create new cast-iron brackets.

2.7 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or Class II, 0.010 mm or thicker as directed over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish as directed.

C. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or Class II, 0.010 mm or thicker as directed over a satin (directionally textured). polished (buffed) or nonspecular as fabricated mechanical finish as directed.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.8 COPPER-ALLOY FINISHES

A. General: Finish designations for copper alloys comply with the system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: As directed M21 (Mechanical Finish: buffed, smooth specular) or M22 (Mechanical Finish: buffed, specular).

C. Buffed Finish, Lacquered: M22 (Mechanical Finish: buffed, specular; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (Mechanical Finish: directionally textured, medium satin and hand rubbed).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (Mechanical Finish: directionally textured, medium satin and hand rubbed; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: As directed Match design reference sample, Match existing or Match Architect's sample.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: As directed Match design reference sample, Match existingor Match Architect's sample.

H. Patina Finish: as directed.

2.9 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090190.52 "Maintenance Repainting" for finish painting of primed existing metal.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish or Architect's sample as directed, free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: ASTM A480/A480M, No. 4.
4. Dull Satin Finish: ASTM A480/A480M, No. 6.

D. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M, No. 2B.

PART 3 - EXECUTION

3.1 DECORATIVE METAL REPAIR, GENERAL

A. Execution of the Work: In repairing items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize decorative metal to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place where possible.

6. Replace or reproduce items where indicated or scheduled.
7. Install temporary protective measures to stabilize decorative metal that is indicated to be repaired later.

B. Mechanical Coating Removal: Use gentle methods, such as scraping and wire brushing, that will not abrade metal substrate.

C. Repair Decorative Metal Item: Match existing materials and features.

D. Replace Decorative Metal Component: Where indicated, duplicate and replace items with new metal matching existing metal.

1. Replace heavily deteriorated or missing parts or features of decorative metal with compatible materials, using surviving prototypes to create patterns or molds for duplicate replacements.

3.2 PREPARATORY CLEANING

A. General: Use those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being cleaned. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    c. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: As directed Clean with cold or hot water applied by low or medium-pressure spray. Supplement with natural-fiber or plastic-bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic-bristle brush as directed until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. As directed Rinse with cold or hot water applied by low or medium-pressure spray to remove detergent solution and soil.

D. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray. As directed Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous metal cleaning.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 REMOVAL, REPAIR, AND REINSTALLATION

A. General: Perform removal work as required in Section 024119 "Selective Demolition" for specific requirements relating to selectively demolishing construction, including decorative metal removal for repair or reinstallation elsewhere.

B. Defects in Painted Metal Surfaces: Repair nonload-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across as directed, and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

C. Reinstalling Railing and Fence Posts: After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup sloped away from post.

D. Anchoring Wood Rails: Secure wood rails to metal subrail or brackets from bottom of wood rail as indicated on Drawings. Make fastener heads flush to metal surface.

E. Installing Sealant: See Section 079200 "Joint Sealants."

3.4 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.5 DECORATIVE METAL REPAIR SCHEDULE

A. Treatment of Decorative Railing DMR-2: Cast-iron balustrade.

1. General: Perform work in the shop or in the field as directed.
2. Paint Removal: As specified in Section 050170.51 "Decorative Metal Cleaning."
3. Rust Removal: Chemical or Mechanical as directed.
4. Repair: Patch with new material by filling, welding, brazing, or applying new metal material with fasteners.

    a. Apply repair primer immediately after repair.

5. Painted Finish: As specified in Section 090190.52 "Maintenance Repainting.".

B. Treatment of Decorative Railing DMR-3: Bronze railing with bronze handrail.

1. General: Perform work in the shop or in the field.
2. Cleaning: As specified in Section 050170.51 "Decorative Metal Cleaning."
3. Repair: Splice new material into deteriorated section.
4. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

END OF SECTION 050170.61

SECTION 050170.63 - DECORATIVE METAL REFINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes refinishing bare decorative metal surfaces as follows:

1. Refinishing metal in place.
2. Removing metal for shop refinishing; reinstalling refinished metal.
3. Integral metal finishes.
4. Clear protective coatings.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
2. Section 099423 "Gilding" for gilding on metalwork.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s) <Insert range of values>.

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of refinishing work.
2. Include field-verified dimensions.

C. Samples for Initial Selection: For the following:

1. A range of each type of exposed finish prepared on metal of the same alloy matching existing metal.

D. Samples for Verification: For the following products in manufacturer's standard sizes unless otherwise indicated, finished as required for use in the Work:

1. Each type of exposed finish prepared on metal of the same alloy matching existing metal; 6 inches (150 mm) long in least dimension.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For decorative metal refinishing specialist.

1.7 QUALITY ASSURANCE

A. Decorative Metal Refinishing Specialist Qualifications: A qualified decorative metal refinishing specialist.

1. Single Specialist: Subject to compliance with requirements, engage the same specialist firm to perform the work of Section 050170.51 "Decorative Metal Cleaning" Section 050170.61 "Decorative Metal Repair" and the work of this Section.

B. Mockups: Prepare mockups of decorative metal refinishing processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous.

1. Waxing Bronze: Wax a cleaned area approximately 2 sq. ft. (0.2 sq. m) as indicated on Drawings, of each type of, bronze, sculpture, paneling and hardware.
2. Refinishing Decorative Metal: Refinish one, decorative, for each type of metal indicated to be refinished.
3. Repairing Decorative Metal Finish: Repair finish of one, decorative, for each type of metal finish indicated to be repaired.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Pack, deliver, and store decorative metal items in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products are not deformed, cracked, or otherwise damaged.

B. Store decorative metal inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

C. Protect strippable protective covering on decorative metal from exposure to sunlight and high humidity, except to the extent necessary for the period of decorative metal installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with decorative metal refinishing only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials, including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.
2. Blasting Abrasive: Pulverized walnut shells, Powdered aluminum silicate and or as directed.
3. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

2.2 PROTECTIVE COATING MATERIALS

A. Wax Coating: Inert, high-melting-point wax or wax blend, consisting primarily of carnauba or microcrystalline petroleum wax and no solvents.

B. Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole UV inhibitor.

C. Copper-Alloy Corrosion Inhibitor: Solution of 1 to 3 percent benzotriazole in water.

2.3 MISCELLANEOUS MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces, and that will easily come off entirely, including adhesive.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

    a. Remove, alter, or in any way harm the present or future condition of existing surfaces, including surrounding surfaces not in the Contract.
    b. Leave an unintended residue on surfaces.

2.4 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Unfinished: No applied finish; only preparatory cleaning.

B. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed), nonspecular as fabricated, mechanical finish.

C. Color Anodic Finish: AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed), nonspecular as fabricated, mechanical finish.

2.6 COPPER-ALLOY FINISHES

A. General: Finish designations for copper alloys comply with the system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular), M22 (Mechanical Finish: buffed, specular).

C. Buffed Finish, Lacquered: M22 (Mechanical Finish: buffed, specular; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (Mechanical Finish: directionally textured, medium satin and hand rubbed).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (Mechanical Finish: directionally textured, medium satin and hand rubbed; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: Match design reference sample, Match existing, Match Architect's sample and or as directed.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: Match design reference sample, Match existing, Match Architect's sample and or as directed.

H. Bright-Relieved Statuary Conversion Coating, Lacquered: M12-C55-M2x-06x (matte finish as cast; sulfide conversion coating; buffed to brighten high spots; specified clear organic coating):

1. Color and Buffing: Match design reference sample, Match existing, Match Architect's sample and or as directed.

I. Patina Finish: and or as directed.

2.7 FERROUS METAL FINISHES

A. Patina Finish: and or as directed.

2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish, Architect's sample], free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

3. Directional Satin Finish: ASTM A480/A480M, No. 4.
4. Dull Satin Finish: ASTM A480/A480M, No. 6.
5. Reflective, Directional Polish: ASTM A480/A480M, No. 7.
6. Mirrorlike Reflective, Nondirectional Polish: ASTM A480/A480M, No. 8.

PART 3 - EXECUTION

3.1 DECORATIVE METAL REFINISHING SPECIALIST

A. Decorative Metal Refinishing Specialist Firms: Subject to compliance with requirements, provide decorative metal refinishing by one of the following, firms that may provide decorative metal refinishing include, but are not limited to, the following:

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proved to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 DECORATIVE METAL REFINISHING, GENERAL

A. Refinishing Appearance Standard: Refinished surfaces are to have a uniform appearance as viewed from 20 feet (6 m), 50 feet (15 m) and as directed.

B. Execution of the Work: In refinishing items, disturb remaining existing work as minimally as possible and as follows:

1. Remove dirt and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Refinish items in place where possible and according to required appearance.

C. Refinish Decorative Metal Item: Remove existing metal finishes on item unless otherwise indicated, including integral polished and patinated finishes, and reapply them.

D. Repair Finish of Decorative Metal Item: Restore areas of deteriorated or missing finish on item and blend restored finish with existing, adjacent finish, including integral polished and patinated finishes.

3.4 PREPARATORY CLEANING

A. General: Use those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

B. Water Cleaning: Clean with cold, hot water applied by low, medium, high-pressure spray. Supplement with natural-fiber, or plastic-bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic-bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. As directed rinse with cold or hot water applied by low, medium, high-pressure spray to remove detergent solution and soil.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.

3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup, of two to three minutes.
4. Nonferrous Metals: Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray, Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

F. Cleaning by Abrasive Blasting: Clean surfaces to remove dirt, leaving uniform patina intact, by dry blasting with specified blasting abrasive at pressure and distance from surface indicated below. Rinse with cold water, low-pressure spray to remove residue. Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

1. Pressure and Distance from Surface: Maximum pressure of 60 psi (415 kPa), 100 psi (690 kPa), 200 psi (1375 kPa) with specified blasting abrasive propelled from a distance of 6 to 12 inches (152 to 305 mm), 12 to 18 inches (305 to 457 mm) from the surface.
2. Pressure and Distance from Surface: As established by mockup.

3.5 PROTECTIVE COATING

A. Protective Hot-Wax Coating: Pretreat cleaned copper-alloy surfaces with copper-alloy corrosion inhibitor, wipe off excess with ethanol-saturated rag, and allow surface to dry. If fresh corrosion appears, repeat process. Apply wax coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being waxed.
2. Preheat surface to about 212 deg F (100 deg C); hot enough to melt the wax and remove water vapor and other gases within metal surface, but not hot enough to boil the wax or ignite solvents if any.
3. Apply uniform wax coating to surface, ensuring that wax coverage is complete, including recesses. Apply second wax coating following the same process.
4. Inspect surface and repair holidays by reheating and applying more wax.
5. Buff waxed surface to a slight shine with a lint-free cloth after wax has cooled to a hazy appearance.

B. Protective Organic Coating: Pretreat cleaned copper-alloy surfaces with copper-alloy corrosion inhibitor, wipe off excess with ethanol-saturated rag, and allow surface to dry. If fresh corrosion appears, repeat process. Apply organic coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being coated.
2. Apply two uniform coats by air-spray method according to manufacturer's written instructions, with interim drying between coats.
3. Apply coating to a total dry film thickness of 1 mil (0.025 mm).

4. Protect coated surface from contamination until fully cured.

3.6 REMOVAL, REPAIR, AND REINSTALLATION

A. General: Perform removal, repair, and reinstallation work as required in Section 024119 "Selective Demolition" and Section 050170.61 "Decorative Metal Repair."

3.7 DECORATIVE METAL REFINISHING SCHEDULE

A. Treatment of Decorative Handrail DMR-# : Tarnished bronze railing with bronze handrail.

1. General: Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning, Chemical cleaning, Abrasive blasting.
3. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

B. Treatment for Bronze Statue Finish DMS-# : Clean, repair patina finish, and coat statue.

1. General: Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning, Chemical cleaning, Abrasive blasting.
3. Finish Repair: Selectively patinate the nose, foot, and previous metal repairs to match the rest of the statue.
4. Protective Coating: Protective hot-wax, organic coating.

END OF SECTION 050170.63

SECTION 050371 - HISTORIC DECORATIVE METAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment of decorative metal in the form of cleaning as follows:

1. Cleaning metal.
2. Removing paint.
3. Removing corrosion.
4. Priming for repainting.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

C. High-Pressure Spray:

1. Pressure: 800 to 1200 (5510 to 8250) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal.

2. Review methods and procedures related to historic treatment of decorative metal including, but not limited to, the following:

    a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Materials, material application, and sequencing.
    c. Fire-protection plan.
    d. Decorative metal historic treatment program.
    e. Coordination with building occupants.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist, chemical-cleaner manufacturer, paint-remover manufacturer.

B. Decorative Metal Historic Treatment Program: For cleaning historic decorative metalwork.

C. Preconstruction Test Reports: For chemical cleaning of and paint removal from historic decorative metal.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal cleaning specialist. Cleaning specialist shall be experienced in using mechanical and chemical methods on the types of metal surfaces indicated.

1. Single Specialist: Have the work of this Section, Section 050372 "Historic Decorative Metal Repair", Section 050373 "Historic Decorative Metal Refinishing", Section 050374 "Historic Decorative Metal Replication" and Section 050383 "Historic Cast Iron Repair" performed by the same historic treatment specialist firm, meeting the specialist qualifications of those Sections.

B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing metal cleaners that have been used for similar historic decorative metal applications with successful results and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing paint removers that have been used for similar historic decorative metal applications with successful results and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

D. Decorative Metal Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including each process or phase of cleaning decorative metal, related work, and the protection of surrounding materials and Project site.

1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

E. Mockups: Prepare mockups of historic treatment cleaning processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous.

1. Cleaning: Prepare an area approximately 2 sq. ft. (0.2 sq. m), as indicated on Drawings for each process on each type of metal indicated for treatment.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist or one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on each type of historic metal.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic treatment of decorative metal only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra fine bronze wool or plastic abrasive pads.
2. Blasting Abrasive: Pulverized walnut shells, Powdered aluminum silicate and or as directed.
3. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from metals, and containing no methylene chloride.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming alkaline paste or gel formulation for removing paint from metal, and containing no methylene chloride.

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from metals.

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from metals; and containing no methanol or methylene chloride.

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from metals; and containing no methanol or methylene chloride.

2.3 MISCELLANEOUS MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces; and that will easily come off entirely, including adhesive.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

    a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in the Contract.
    b. Leave an unintended residue on surfaces.

2.4 FERROUS METAL PRIMERS

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed historic metal.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements provide historic decorative metal cleaning by one of the following, firms that may provide historic decorative metal cleaning include, but are not limited to, the following:

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.

4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 HISTORIC DECORATIVE METAL CLEANING, GENERAL

A. Have historic decorative metal cleaning performed by a historic treatment specialist.

B. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 (6), 50 (15) feet (m) away by Architect.

C. Execution of the Work: In cleaning historic items, disturb them as minimally as possible and as follows:

1. Remove deteriorated coatings and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Clean items in place unless otherwise indicated.

D. Mechanical Coating Removal: Use most gentle mechanical methods, such as scraping and wire brushing, that will not abrade metal substrate. Do not use abrasive methods such as sanding or power tools except as indicated as part of the historic treatment program and approved by Architect.

E. Repaint: Where indicated, prepare painted decorative metal by cleaning surface, removing less than firmly adhered existing paint, sanding edges smooth, removing existing paint and priming for painting as specified.

3.4 CLEANING

A. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

B. Water Cleaning: Clean with cold, hot water applied by low, medium, high-pressure spray. Supplement with natural-fiber or plastic bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold, hot water applied by low, medium, high-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with cold, hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup, of two to three minutes.
4. Non-Ferrous Metals: Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.
6. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup. Do not repeat more than once.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray, Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

F. Cleaning by Abrasive Blasting: Clean surfaces to remove dirt, leaving uniform patina intact, by dry blasting with specified blasting abrasive at pressure and distance from surface indicated below. Rinse with cold water, low-pressure spray to remove residue, Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

1. Pressure and Distance from Surface: Maximum pressure of 60 (415), 100 (690), 200 (1375) psi (kPa) with specified blasting abrasive propelled from a distance of 6 to 12 (152 to 305), 12 to 18 (305 to 457) inches (mm) from the surface.
2. Pressure and Distance from Surface: As established by mockup.

G. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

H. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous metal cleaning.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 PAINT REMOVAL

A. Use only those paint-removal methods indicated for each type of decorative metal.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

    a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
    b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.

2. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. Unless otherwise indicated, hold spray nozzle at least 6 inches (152 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
    c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with cone-shaped spray.
    d. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    e. For high-pressure water-spray application, use fan-shaped spray tip that disperses water at an angle of at least 40 degrees.

f. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
8. For spots of remaining paint, apply alkaline paste paint remover according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush; or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold, hot, water applied by low, medium, high-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove remaining chemicals and paint residue.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify testing agency in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors have had reasonable opportunity to inspect work areas at locations of lift devices or scaffolding.

C. Manufacturer's Field Service: Engage chemical-cleaner and paint-remover manufacturers' factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and to provide on-site assistance when requested by Architect.

3.7 REMOVAL, DISMANTLING, AND REINSTALLATION

A. Perform removal, dismantling, and reinstallation work as required in Section 024296 "Historic Removal and Dismantling" and Section 050372 "Historic Decorative Metal Repair."

3.8 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.9 HISTORIC DECORATIVE METAL CLEANING SCHEDULE

A. Treatment of Decorative Railing DMR-1: Wrought-iron railing and gate.

1. Perform work in the shop or in the field.
2. Paint Removal: Alkaline paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type paste paint remover, Low-odor, solvent-type paste paint remover Covered, solvent-type paint remover.
3. Repairs: As specified in Section 050372 "Historic Decorative Metal Repair."

4. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting." And or as directed.

B. Treatment of Decorative Railing DMR-2: Cast-iron balustrade.

1. Perform work in the shop or in the field.
2. Paint Removal: Alkaline paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type paste paint remover, Low-odor, solvent-type paste paint remover Covered, solvent-type paste paint remover.
3. Rust Removal: Chemical, Mechanical.
4. Repair: As specified in Section 050372 "Historic Decorative Metal Repair."
5. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting." And or as directed.

C. Treatment of Decorative Railing DMR-3: Bronze railing with bronze handrail.

1. Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning, Chemical cleaning, Abrasive blasting.
3. Repair: As specified in Section 050372 "Historic Decorative Metal Repair."
4. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

D. Treatment of Decorative Cast-Iron Facade and Storefront DMFS-# ands or as directed: Repair facade and storefront and replace missing components.

1. Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning, Chemical cleaning, Abrasive blasting.
3. Paint Removal: Alkaline paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type paste paint remover, Low-odor, solvent-type paste paint remover Covered, solvent-type paste paint remover.
4. Rust Removal: Chemical, Mechanical.
5. Repair: As specified in Section 050372 "Historic Decorative Metal Repair."
6. Finish Treatment: As specified in Section 050373 "Historic Decorative Metal Refinishing." Section 090391 "Historic Treatment of Plain Painting."

E. Treatment of Bronze Grille DMG-#: Strip paint and coat grille.

1. Perform work in the shop or in the field.
2. Paint Removal: Solvent-type paste paint remover, Low-odor, solvent-type paste paint remover, Covered, solvent-type paste paint remover.
3. Protective Coating: As specified in Section 050373 "Historic Decorative Metal Refinishing."

END OF SECTION 050371

SECTION 050372 - HISTORIC DECORATIVE METAL REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment of decorative metal in the form of repair as follows:

1. Repairing metals other than cast iron and replacing damaged and missing components in place.
2. Removing and dismantling metal for shop repair and replacement of components; reinstalling repaired metal.
3. Painting steel uncovered during the Work.
4. Installing wood rails supported by or attached to decorative metal railings or brackets.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 ALLOWANCES

A. Allowances for historic treatment of decorative metals are specified in Section 012100 "Allowances."

1. Perform historic treatment of decorative metals under quantity allowances and only as authorized. Authorized work includes work required by Drawings and Specifications and work as directed in writing by Architect.
2. Notify Architect weekly and or as directed of extent of work performed that is attributable to quantity allowances.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Repairing as directed.

1.4 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal.
2. Review methods and procedures related to historic decorative metal repair including, but not limited to, the following:

    a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Materials, material application, sequencing, tolerances, and required clearances.
    c. Fire-protection plan.
    d. Decorative metal historic treatment program.
    e. Coordination with building occupants.

1.6 SEQUENCING AND SCHEDULING

A. Perform decorative metal repair in the following sequence, which includes work specified in this and other Sections:

1. Dismantle existing surface-mounted objects and hardware that overlie decorative metal surfaces except items indicated to remain in place. Tag items with location identification and protect.
2. Verify that temporary protections have been installed.
3. Examine condition of decorative metal.
4. Clean decorative metal surface, and remove paint and other finishes to the extent required.
5. Repair and replace existing decorative metal and supports to the degree required for a uniform and sound surface on which to paint or apply other finishes.
6. Cure repaired surfaces and allow them to dry for proper finishing.
7. Paint and apply other finishes.
8. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.
2. Include field-verified dimensions and the following:

a. Full-size patterns with complete dimensions for new decorative metal components and their jointing, showing relation of existing to new components.
b. Templates and directions for installing anchor bolts and other anchorages.
c. Identification of each new metal item and component and its location on the structure in annotated plans and elevations.
d. Provisions for expansion, weep holes, and conduits as required for each location and exposure.
e. Provisions for sealant between decorative metal components and for sealant-type joints if required.

C. Samples for Initial Selection: For each type of decorative metal item and component with factory-applied finishes.

1. Include samples of sealant materials, miscellaneous materials, and accessories involving size, color, or finish selection.

D. Samples for Verification: For the following products in manufacturer's standard sizes unless otherwise indicated, finished as required for use in the Work:

1. Each type of new material to be used for replacing existing or missing decorative metal; 6 inches (150 mm) long in least dimension or whole item.

a. Patterns for Casting: Before casting components, submit the actual patterns from which molds will be made for casting. Package and ship to prevent loss or damage, or make patterns available for inspection by Architect at fabrication plant.
b. Casting Samples: For castings, provide one of each shape, color, and texture of component, suitable and ready for installation. Make this submittal after acceptance of patterns for casting.

2. Fittings and brackets.
3. Each type of exposed connection between components. Show method of finishing components at connections.
4. Each type of exposed finish prepared on metal of the same alloy to be used for the Work of this Section; 6 inches (150 mm) long in least dimension.
5. Wood Rail: 12 inches (300 mm) long.
6. Sealant materials.
7. Accessories: Each type of anchor, accessory, and miscellaneous support in required finishes.

E. Delegated-Design Submittal: For structural performance of repaired railings, handrails, handrail brackets and anchors, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist.

B. Evaluation Reports: For post-installed structural anchors, from ICC-ES.

C. Decorative Metal Historic Treatment Program: For repairing historic decorative metalwork.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents, including material, finish, source, and location on or in building.

1. Cast Metal Replications: Five, additional castings of each type, cast grilles of each type .
2. Wrought-Iron Decorative Railing Posts: Five additional posts of each type.

B. Molds for Castings: On completion of manufacturing of cast components, deliver one unused mold of each shape and size of component to Project site. Deliver to a location and at a time determined by Owner, to become property of Owner.

1. Deliver molds carefully packed, protected from dirt, moisture, and breakage so as to arrive in usable, undamaged condition and enable long-term storage and possible future use.

1.10 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal repair specialist. Repair specialist shall be experienced in forge welding. Experience in torch- or arc-welding and installing and finishing new decorative metal work is insufficient experience for decorative metal historic treatment work.

1. Single Specialist: Have the work of Section 050371 "Historic Decorative Metal Cleaning", Section 050372 "Historic Decorative Metal Repair", Section 050373 "Historic Decorative Metal Refinishing", Section 050374 "Historic Decorative Metal Replication" and Section 050383 "Historic Cast Iron Repair" performed by the same historic treatment specialist firm, meeting the specialist qualifications of those Sections.

B. Decorative Metal Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic decorative metal repair work, including each process or phase of repairing decorative metal, related work, and the protection of surrounding materials and Project site.

1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

C. Mockups: Prepare mockups of historic treatment repair processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Replacing Metal Component: Two each of wrought-iron spirals replaced on gate and cast-bronze wall registers.

2. Cast-Metal Components: Submit patterns, models, or plaster castings made from existing decorative metal for each replacement casting required.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic treatment of decorative metal only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, handrails, handrail brackets and anchors according to structural performance requirements.

B. Structural Performance: Railings, handrails and handrail brackets, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METAL MATERIALS

A. Provide metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated. Exposed-to-view surfaces exhibiting imperfections inconsistent with existing materials are unacceptable.

B. Source Limitation for Replacement Cast Materials: Obtain castings for historic treatment of decorative metal from single source from single manufacturer with resources to provide materials of consistent quality in appearance and physical properties.

C. Aluminum: Alloy and temper recommended in writing by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:

1. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), Alloy 6063-T6.
2. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.

3. Drawn General-Purpose Seamless Tubes: ASTM B210 (ASTM B210M), Alloy 6063-T832.
4. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
5. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.
6. Castings: ASTM B26/B26M, Alloy A356-T6.

D. Copper Alloys, Bronze:

1. Extruded Shapes: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze, 57 percent copper, 40 percent zinc, and 3 percent lead).
2. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper and 40 percent zinc).
3. Seamless Pipe: ASTM B43, Alloy UNS No. C23000 (red brass, 85 percent copper and 15 percent zinc).
4. Seamless Tubes: ASTM B135 (ASTM B135M), Alloy UNS No. C23000 (red brass, 85 percent copper and 15 percent zinc).
5. Composition Bronze Castings: ASTM B62, Alloy UNS No. C83600 ("85-5-5-5" is the common trade name; 85 percent copper and 5 percent each of tin, lead, and zinc).
6. Sand Castings: ASTM B584, Alloy UNS No. C86500 (No. 1 manganese bronze; 58 percent copper, 39 percent zinc, 1 percent manganese, and small amounts of other metals).

E. Copper Alloys, Brass:

1. Extruded Shapes: ASTM B249/B249M, Alloy UNS No. C36000 (free-cutting brass, 60 percent copper, 36 percent zinc, and small amounts of other metals).
2. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C26000 (cartridge brass, 70 percent copper and 30 percent zinc).
3. Seamless Tubes: ASTM B135 (ASTM B135M), Alloy UNS No. C26000 (cartridge brass, 70 percent copper and 30 percent zinc).
4. Sand Castings: ASTM B584, Alloy UNS No. C85200 (high-copper yellow brass, 72 percent copper, 24 percent zinc, and small amounts of other metals).

F. Monel (Nickel-Copper Alloy):

1. Plate, Sheet, and Strip: ASTM B127, Alloy UNS No. N04400.
2. Rod, Bar, and Wire: ASTM B164, Alloy UNS No. N04400.
3. Seamless Tubes: ASTM B165, Alloy UNS No. N04400.
4. Forgings: ASTM B564, Alloy UNS No. N04400.
5. Sand Castings: Monel alloy matching Alloy UNS No. N04400.

G. Nickel Silver (Copper-Nickel-Zinc Alloy):

1. Extruded Shapes: ASTM B151/B151M, Alloy UNS No. C74500, UNS No. C75200.
2. Plate, Sheet, Strip, and Bar: ASTM B122/B122M, Alloy UNS No. C74500 UNS No. C75200.

H. Stainless Steel:

1. Tubing: ASTM A554, Grade MT-304, Grade MT-316.
2. Pipe: ASTM A312/A312M, Grade TP304, Grade TP316.

3. Castings: ASTM A743/A743M, Grade CF8 or CF20, Grade CF8M.
4. Strip, Plate, and Flat Bar: ASTM A666, Type 304, Type 316.
5. Bars and Shapes: ASTM A276, Type 304, Type 316.

I. Steel:

1. Tubing: Cold formed, ASTM A500/A500M.
2. Steel Plate, Shapes, and Bars: ASTM A36/A36M.
3. Steel Bars: Mild steel; ASTM A29/A29M, Grade 1010.
4. Steel Sheet: ASTM A1008/A1008M, cold-rolled commercial steel sheet; matte finish; suitable for exposed applications.

J. Cast Iron: Standard designated below for each type of casting:

1. Gray-Iron Castings: ASTM A48/A48M, Class 30.
2. Malleable-Iron Castings: ASTM A47/A47M, grade as recommended in writing by fabricator for type of use indicated.

K. Wrought Iron: Pure iron with not more than 0.035 percent carbon and containing fibrous slag (iron silicate), Pure iron with not more than 0.035 percent carbon and no slag (iron silicate) or mild steel; ASTM A29/A29M, Grade 1010; hand worked or machine forged to the form indicated.

2.3 WOOD MATERIALS

A. Wood Rails: Hardwood rails of species and profile indicated, with transparent finish, and prepared for securing to metal subrail or brackets as indicated on Drawings.

1. Species and Finish: Match design reference sample, Match existing, As indicated on Drawings, Ash, natural finish, Cherry, natural finish, Walnut, natural finish, White oak, light-stained finish.
2. Profile: Match design reference sample, Match existing, As indicated on Drawings Square shape, 1-3/4 by 1-3/4 inches (45 by 45 mm), with edges eased to 1/4-inch (6-mm) radius, Rectangular shape, 1-3/4 by 5 inches (45 by 127 mm), with edges eased to 1/4-inch (6-mm) radius, Round shape, 2-inch (50-mm) diameter.

B. Wood Rails: Hardwood rails of species and profile matching design reference sample, matching existing, as indicated on Drawings, complying with Section 050383 "Historic Cast Iron Repair." Section 060312 "Historic Wood Repair." Section 064013 "Exterior Architectural Woodwork." Section 064023 "Interior Architectural Woodwork."

2.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Abrasive Materials:

1. Abrasive Pads: Non-scratch, of the following type(s):

   a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
   b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
3. Medium Abrasives for Copper Alloys: Extra fine bronze wool or plastic abrasive pads.
4. Blasting Abrasive: Pulverized walnut shells, Powdered aluminum silicate.

E. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.5 FASTENERS

A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting decorative metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated or another head is required to match the existing fastening method as determined by Architect.
4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.

B. Post-Installed Structural Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

1. Uses: Securing railings, handrails and handrail brackets to structure.
2. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Post-Installed Nonstructural Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

1. Type: Expansion anchor, adhesive anchor, types matching existing or types indicated on Drawings.
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.6 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Brazing Rods for Copper Alloys: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for color match, strength, and compatibility in fabricated items.

C. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as required for color match, strength, and compatibility in fabricated items.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior use.

F. Sealant Materials:

1. Provide manufacturer's standard, elastomeric nonstaining, single-component, nonsag silicone, single-component, nonsag urethane sealant complying with applicable requirements in Section 079200 "Joint Sealants."

2. Colors: Provide colors of exposed sealants to match colors of metals in which sealant is placed unless otherwise indicated.

G. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29.

1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" surface preparation according to manufacturer's literature or certified statement.
2. VOC Limit: Use coating with a VOC content of 400 g/L (3.3 lb/gal.)

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

I. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.

J. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces, and that will easily come off entirely, including adhesive.

K. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in the Contract.
b. Leave an unintended residue on surfaces.

2.7 METAL FABRICATION

A. Custom fabricate repairs of decorative metal items and components in sizes and profiles to match existing decorative metal unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide uniform, neat seams with minimum exposure of welds, brazing, solder, and sealant.

C. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

D. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
2. Remove flux immediately.
3. At exposed connections, match contours of adjoining surfaces, and finish exposed surfaces smooth and blended so no roughness shows after finishing.

E. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

1. Finish castings to match existing decorative metal work.
2. Replacement Casting for Handrail Bracket: Duplicate existing handrail bracket on the wrought-iron railing of first-floor stairs in the lobby. Make molds from this bracket to create new cast-bronze brackets.

F. Date Identification: Emboss on a concealed, interior surface of the metal body of each new component, in easily read characters, "MADE." Manufacturer's name may also be embossed. For cast metals, add the identification to the mold pattern before casting. For malleable metals, stamp identification with an imprinting tool.

2.8 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed), nonspecular as fabricated, mechanical finish.

C. Color Anodic Finish: AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed), nonspecular as fabricated, mechanical finish.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.10 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular), M22 (buffed, specular mechanical finish).

C. Buffed Finish, Lacquered: M22 (Mechanical Finish: buffed, specular; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (Mechanical Finish: directionally textured, medium satin and hand-rubbed).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (Mechanical Finish: directionally textured, medium satin and hand-rubbed; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: Match design reference sample, Match existing, Match Architect's sample and or as directed.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: Match design reference sample, Match existing, Match Architect's sample.

H. Bright-Relieved Statuary Conversion Coating, Lacquered: M12-C55-M2x-06x (matte finish as cast; sulfide conversion coating; buffed to brighten high spots; specified clear organic coating):

1. Color and Buffing: Match design reference sample, Match existing, Match Architect's sample.

I. Patina Finish:

2.11 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed metal.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

D. Patina Finish:

2.12 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish, Architect's sample, free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: ASTM A480/A480M, No. 4.
4. Dull Satin Finish: ASTM A480/A480M, No. 6.
5. Reflective, Directional Polish: ASTM A480/A480M, No. 7.
6. Mirrorlike Reflective, Nondirectional Polish: ASTM A480/A480M, No. 8.

D. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M, No. 2B.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements provide historic decorative metal repair by one of the following, firms that may provide historic decorative metal repair include, but are not limited to, the following:

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proved to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 HISTORIC DECORATIVE METAL REPAIR, GENERAL

A. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m), 50 feet (15 m) and or as directed away by Architect.

B. Execution of the Work: In repairing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize decorative metal to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place unless otherwise indicated and retain as much original material as possible.
6. Replace or reproduce historic items where indicated or scheduled.
7. Make historic treatment of materials reversible whenever possible.
8. Install temporary protective measures to stabilize decorative metal that is indicated to be repaired later.

C. Mechanical Coating Removal: Use gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as indicated as part of the historic treatment program and approved by Architect.

D. Repairing Decorative Metal Items: Match existing materials and features, retaining as much original material as possible to complete the repair.

1. Unless otherwise indicated, repair decorative metals by patching, filling, piecing-in, splicing, or otherwise reinforcing metals with new material matching existing.
2. Where indicated, repair decorative metal by limited replacement to the extent indicated, matching existing material.

E. Replacing Decorative Metal Components: Where indicated, duplicate and replace items with new metal matching existing metal.

1. Replace heavily deteriorated or missing parts or features of decorative metal with compatible materials, using surviving prototypes to create patterns or molds for duplicate replacements.
2. Do not use substitute materials unless otherwise indicated.
3. Compatible substitute materials may be used.

3.4 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    c. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

B. Water Cleaning: Clean with cold, hot, water applied with sponges or wash cloths, low-pressure spray, medium-pressure spray, high-pressure spray. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil and loose paint from joints and crevices. Leave uniform patina intact.

C. Detergent Cleaning:

1. Wet surface with cold, hot, water applied with sponges or wash cloths, low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Leave uniform patina intact.
3. Rinse with cold, hot, water applied with sponges or wash cloths, low-pressure spray, medium-pressure spray, high-pressure spray to remove detergent solution and soil.

D. Cleaning by Abrasive Blasting: Clean surfaces to remove dirt and loose paint by dry blasting with specified blasting abrasive at pressure and distance from surface indicated below. Rinse with cold-water, low-pressure spray to remove residue. Do not rinse ferrous metals with water; wipe with soft brushes and damp cloths to remove residue. Leave uniform patina intact.

1. Pressure and Distance from Surface: Maximum pressure of 60 psi (415 kPa), 100 psi (690 kPa), 200 psi (1375 kPa) with specified blasting abrasive propelled from a distance of 6 to 12 inches (152 to 305 mm), 12 to 18 inches (305 to 457 mm) from surface.
2. Pressure and Distance from Surface: As established by mockup.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved, medium abrasives for ferrous metals.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 DISMANTLING, REPAIR, AND INSTALLATION

A. Repair decorative metal in place insofar as practicable, unless otherwise indicated. Where necessary, dismantle components from their substrate and repair and reinstall according to approved historic treatment program.

B. Perform dismantling work as required in Section 024296 "Historic Removal and Dismantling."

C. Installation:

1. Locate and place decorative metal iron items level and plumb and in alignment with adjacent construction.

    a. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

2. Use concealed anchorages where possible, unless otherwise indicated.
3. Form tight joints with exposed connections accurately fitted together.
4. Install concealed joint fillers, sealants, and flashings, as the Work progresses, to make exterior items weatherproof.
5. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
6. Touch Up: At completion of installation, touch up and restore damaged or defaced finish surfaces and fastener heads.

D. Reinstalling Railing and Fence Posts: After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave

anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup sloped away from post.

E. Anchoring Wood Rails: Secure wood rails to metal subrail or brackets from bottom of rail as indicated on Drawings. Make fastener heads flush to metal surface of subrail or brackets.

F. Sealant: Clean and prepare joint surfaces and apply and cure sealant according to Section 079200 "Joint Sealants."

1. Keep joints to receive sealant dry and free of debris.
2. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Apply sealant on joint surfaces between abutting cast-metal components in a continuous application immediately before joining the components together. Remove excess after components are joined and tightened.
4. Fill sealant-type joints with specified joint sealant as recommended in writing by sealant manufacturer and the following:

    a. Install sealant using only proved installation methods that ensure sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding metal.
    b. Do not allow sealant to overflow or spill onto adjoining surfaces or to migrate into the voids of adjoining surfaces, particularly rough or sculptural textures. Promptly remove excess and spillage of sealant as the work progresses. Clean adjoining surfaces by means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

3.6 FILLING DEFECTS IN PAINTED SURFACES

A. Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm), 1/8 inch (3 mm) deep or 1/2 inch (13 mm), 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound. Remove burrs. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

1. Apply metal-patching compound to fill depressions, nicks, cuts, and other voids created by rusted, removed, or missing metal.
2. Mix only as much patching compound as can be applied according to manufacturer's written instructions.
3. Apply patching compound in layers of maximum 1/8 inch (3 mm) thickness and as recommended in writing by manufacturer until the void is completely filled.
4. Finish patch surface smooth and shaped flush with adjacent contours, without voids in patch material.
5. Clean spilled compound from adjacent materials immediately.

3.7 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.8 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during metal removal. Where Architect determines that the steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:

1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning," SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," and or as directed as applicable to comply with paint manufacturer's recommended preparation.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

B. If on inspection and rust removal the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm) notify Architect before proceeding.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify testing agency in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors have had reasonable opportunity to inspect work areas at locations of lift devices or scaffolding.

3.10 HISTORIC DECORATIVE METAL REPAIR SCHEDULE

A. Treatment of Decorative Railing DMR-1: Wrought-iron railing and gate.

1. Perform work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repairs: Repair railing and replace missing components with hand-worked steel bars, wrought iron.
4. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting." And or as directed.
5. Baked-Enamel or Powder-Coat Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample, Color as selected by Architect from manufacturer's full range and or as directed.
6. Gilding: As specified in Section 090398 "Historic Treatment of Gilding."

B. Treatment of Decorative Railing DMR-2: Bronze railing with bronze handrail.

1. Perform work in the shop or in the field.
2. Cleaning: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repair: Splice new material into deteriorated section and or as directed.

4. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

C. Treatment of Decorative Railing and Handrail DMRH-1: Deteriorated bronze, wood handrail on wrought-iron railing.

1. Repair: Replace broken wrought-iron railing components and repaint railing. Replace entire, deteriorated bronze, wood handrail with shop-fabricated aluminum, steel, wood handrail. Replicate wrought-iron as specified in Section 050374 "Historic Decorative Metal Replication."
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Railing Finish: Paint as specified in Section 090391 "Historic Treatment of Plain Painting."

    a. Color: As indicated by manufacturer's designations, Matching design reference sample, Matching Architect's sample, As selected by Architect from manufacturer's full range.

4. Gilding: As specified in Section 090398 "Historic Treatment of Gilding."
5. Handrail Finish:

    a. Aluminum Finish: Light bronze anodized, Medium bronze anodized, Dark bronze anodized, Anodized color matching design reference sample, Anodized color matching Architect's sample, Anodized color as selected by Architect from full range of industry colors and color densities.
    b. Baked-Enamel or Powder-Coat Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample, Color as selected by Architect from manufacturer's full range.

END OF SECTION 050372

SECTION 050373 - HISTORIC DECORATIVE METAL REFINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative metal in the form of refinishing bare metal surfaces as follows:

1. Refinishing metal in place.
2. Removing and dismantling metal for shop refinishing; reinstalling refinished metal.
3. Integral metal finishes.
4. Metallic-plated finishes.
5. Clear protective coatings.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 050371 "Historic Decorative Metal Cleaning" for cleaning and removing paint from historic metalwork.
3. Section 090391 "Historic Treatment of Plain Painting" for plain painting of historic metalwork.
4. Section 090398 "Historic Treatment of Gilding" for gilding on historic metalwork.

1.2 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 (690 to 2750) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 (2750 to 5510) psi (kPa).
2. Flow Rate: 4 to 6 (0.25 to 0.4) gpm (L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal.
2. Review methods and procedures related to historic treatment of decorative metal.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal refinishing specialist.

B. Mockups: Prepare mockups of historic treatment refinishing processes to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous or reversible.

1. Waxing Bronze: Wax a cleaned area approximately 2 sq. ft. (0.2 sq. m) as indicated on Drawings of each type of bronze sculpture, paneling and hardware.
2. Refinishing Decorative Metal: Refinish one decorative for each type of metal indicated to be refinished.
3. Repairing Decorative Metal Finish: Repair finish of one decorative for each type of metal finish indicated to be repaired.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.
2. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

2.2 PROTECTIVE COATING MATERIALS

A. Wax Coating: Inert, high-melting-point wax or wax blend, consisting primarily of carnauba or microcrystalline petroleum wax and no solvents.

B. Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole UV inhibitor.

2.3 ALUMINUM FINISHES

A. Unfinished: No applied finish; only preparatory cleaning.

B. Clear Anodic Finish: As directed AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish.

C. Color Anodic Finish: As directed AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish.

2.4 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system defined in NAAMM/NOMMA 500, "Metal Finishes Manual for Architectural and Metal Products."

B. Buffed Finish: M21 (buffed, smooth specular mechanical finish) or M22 (buffed, specular mechanical finish) as directed.

C. Buffed Finish, Lacquered: M22 (buffed, specular mechanical finish; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (directionally textured, medium satin and hand-rubbed mechanical finishes).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (directionally textured, medium satin and hand-rubbed mechanical finishes; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: Match design reference sample, Match existing or Match Architect's sample as directed.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: Match design reference sample, Match existing or Match Architect's sample as directed.

H. Patina Finish: As directed.

2.5 FERROUS METAL FINISHES

A. Patina Finish: As directed.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: As directed Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish or Architect's sample, free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches, according to ASTM A480/A480M.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.
4. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL REFINISHING, GENERAL

A. Have decorative metal refinishing performed by a qualified decorative metal refinishing specialist.

B. Refinishing Appearance Standard: As directed Refinished surfaces are to have a uniform appearance as viewed from 20 (6) or 50 (15) feet (m) away by Architect.

C. Execution of the Work: In refinishing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Remove dirt and corrosion.
2. Sequence work to minimize time before protective coatings are reapplied.
3. Refinish items in place unless otherwise indicated and retain as much original finish as possible and according to required appearance.
4. Make historic treatment of materials reversible whenever possible.

D. Refinishing Decorative Metal Item: Remove existing metal finishes on item unless otherwise indicated, including integral polished and patinated finishes and plated finishes, and reapply them or apply new, specified finishes as directed.

E. Repairing Finish of Decorative Metal Item: Restore areas of deteriorated or missing finish on item and blend restored finish with existing, adjacent finish, including integral polished and patinated finishes and plated finishes.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing refinishing work. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gauges.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: As directed Clean with cold or hot water applied by low-pressure spray. Supplement with natural-fiber or plastic bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Leave uniform patina intact.
3. As directed Rinse with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray to remove detergent solution and soil.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. As directed Wet surface with cold or hot water applied by low-pressure spray.

2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer, established by mockup of two to three minutes as directed.
4. Non-Ferrous Metals: As directed Rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.

E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray. Do not rinse ferrous metals with water; wipe with damp cloths to remove residue.

3.3 PROTECTIVE COATING

A. Protective Hot-Wax Coating: Apply wax coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being waxed.
2. Preheat surface to about 212 deg F (100 deg C); hot enough to melt the wax and remove water vapor and other gases within metal surface, but not hot enough to boil the wax or ignite solvents, if any.
3. Apply uniform wax coating to surface, ensuring that wax coverage is complete, including recesses. Apply second wax coating following the same process.
4. Inspect surface and repair holidays by reheating and applying more wax.
5. Buff waxed surface to a slight shine with a lint-free cloth after wax has cooled to a hazy appearance.

B. Protective Organic Coating: Apply organic coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being coated.
2. Apply two uniform coats by air-spray method according to manufacturer's written instructions, with interim drying between coats.
3. Apply coating to a total dry film thickness of 1 mil (0.025 mm).
4. Protect coated surface from contamination until fully cured.

3.4 PLATING

A. Shop Plating: Dismantle from substrate each item indicated for shop plating or replating; disassemble item only as necessary for plating process.

1. Clean item to remove dirt, coatings, and corrosion.
2. Fill scratches, cracks, and depressions and polish or texturize metal surface to match the historic metal; prepare metal surfaces for plating.
3. Plate item to match approved mockup; reassemble and reinstall it.

B. In-Place Plating: Protect from damage the materials surrounding and below each item indicated for in-place plating or replating.

1. Clean item to remove dirt, coatings, and corrosion.
2. Fill scratches, cracks, and depressions and polish or texturize metal surface to match the historic metal; prepare metal surfaces for plating.
3. Plate item to match approved mockup.

3.5 DISMANTLING, REPAIR, AND REINSTALLATION

A. Perform dismantling, repair, and reinstallation work as required in Section 024296 "Historic Removal and Dismantling" and Section 050372 "Historic Decorative Metal Repair."

3.6 HISTORIC DECORATIVE METAL REFINISHING SCHEDULE

A. Treatment of Decorative Handrail DMR-#: Tarnished bronze railing with bronze handrail.

1. Perform work in the shop or in the field.
2. Cleaning: As directed Water cleaning, Detergent cleaning or Chemical cleaning.
3. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

B. Treatment of Decorative Cast-Iron Facade and Storefront DMFS-#: Repair facade and storefront and replace missing components.

1. Perform work in the shop or in the field.
2. Dismantle and Salvage Items: Dismantle the following, return to shop to perform indicated treatment of item, and deliver to Owner for storage for future installation.

    a. Cast-iron medallions.
    b. Salvaged items as directed.

3. Cleaning: Water cleaning, Detergent cleaning or Chemical cleaning as directed.
4. Paint Removal: As directed Alkaline-paste paint remover, Covered or skin-forming alkaline paint remover, Solvent-type paint remover or Low-odor, solvent-type paint remover as specified in Section 050371 "Historic Decorative Metal Cleaning."
5. Rust Removal: As directed Chemical or Mechanical as specified in Section 050372 "Historic Decorative Metal Repair."
6. Repair: As specified in Section 050372 "Historic Decorative Metal Repair."
7. Finish Treatment:

    a. Protective Coating: As directed Hot-wax or Organic coating.
    b. Metal Plating: Plate cast-iron components with brass and nickel where indicated on Drawings.
    c. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting.".

C. Treatment of Bronze Statue Finish DMS-#: As directed Clean, repair patina or plated finish, and coat statue.

1. Perform work in the shop or in the field.
2. Cleaning: Water cleaning, Detergent cleaning or Chemical cleaning.
3. Finish Repair: As directed Selectively patinate, plate the nose, trident, damaged plating and previous metal repairs to match the rest of the statue.
4. Protective Coating: As directed Protective hot-wax or organic coating.

END OF SECTION 050373

SECTION 050374 - HISTORIC DECORATIVE METAL REPLICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative metal in the form of replicating and installing historic items and whole assemblies.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 050372 "Historic Decorative Metal Repair" for repairing historic decorative metalwork, including replicating components that are part of repair work.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal and fire protection.
2. Review methods and procedures related to historic treatment of decorative metal.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new metal item and component and its location on the structure in annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal fabrication and installation specialist. Repair specialist shall be experienced in forge welding. Experience in torch or arc welding and installing and finishing new decorative metalwork is insufficient experience for decorative metal historic treatment work.

B. Mockups: Prepare mockups of historic treatment replication and installation processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Replicated Cut-Out Metal Item: Two cut-out bronze-plate wall registers.

2. Replicated Wrought Iron Railing with Wood Handrail: Approximately 4 feet (1.2 m) in length or Length as indicated on Drawings as directed.
3. Cast-Metal Items: Submit patterns, models, or plaster castings made from existing decorative metal for each replacement casting required.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. General: Provide decorative metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated. Exposed-to-view surfaces exhibiting imperfections inconsistent with existing materials are unacceptable.

2.2 PROTECTIVE COATING MATERIALS

A. Wax Coating: Inert, high-melting-point wax or wax blend, consisting primarily of carnauba or microcrystalline petroleum wax.

B. Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole UV inhibitor.

2.3 MISCELLANEOUS MATERIALS

A. Wood Rails: Hardwood rails of species and profile indicated, with transparent finish, and prepared for securing to metal subrail or brackets as indicated on Drawings.

1. Species and Finish: As directed Match design reference sample, match existing, as indicated on Drawings, Ash, natural finish, Cherry, natural finish, Walnut, natural finish or White oak, light-stained finish.
2. Profile: As directed Match design reference sample, match existing or as indicated on Drawings.

B. Wood Rails: Hardwood rails of species and profile matching design reference sample, matching existing or as indicated on Drawings, complying with Section 062023 "Interior Finish Carpentry", Section 064300 "Wood Stairs and Railings" or Section 064600 "Wood Trim" as directed.

C. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as recommended in writing by producer of metal to be welded or filled and as required for color match, strength, and compatibility in fabricated items.

D. Brazing Rods for Copper-Alloy Components: Type and alloy as recommended in writing by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

E. Brazing Rods for Cast Iron Components: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for strength and compatibility in fabricated items.

F. Fasteners: Fasteners of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting decorative metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
4. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

G. Anchors: Adhesive type, Expansion type or types indicated on Drawings with bolt heads of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal anchored.

1. Strength: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E488 conducted by a qualified independent testing agency.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

2.4 METAL FABRICATION

A. Fabricate decorative metal items and components in sizes and profiles to match existing decorative metal, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

C. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

D. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

1. Finish castings to match existing decorative metalwork.
2. Replacement Casting for Handrail Bracket: Duplicate existing handrail bracket on the cast-iron railing of first-floor stairs in the lobby. Make molds from this bracket to create new cast-iron brackets.

2.5 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish as directed.

C. Color Anodic Finish: As directed AAMA 611, Class I, 0.018 mm or Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603.

2.6 COPPER-ALLOY FINISHES

A. General: Finish designations for copper alloys comply with the system defined in NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: M21 (buffed, smooth specular mechanical finish) or M22 (buffed, specular mechanical finish) as directed.

C. Buffed Finish, Lacquered: M22 (buffed, specular mechanical finish; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (directionally textured, medium satin and hand-rubbed mechanical finishes).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (directionally textured, medium satin and hand-rubbed mechanical finishes; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: Match design reference sample, Match existing or Match Architect's sample.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: Match design reference sample, Match existing, Match Architect's sample.

H. Patina Finish: As directed.

2.7 FERROUS METAL FINISHES

A. Primer: Complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed decorative metal.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish or Architect's sample, free of cross scratches as directed.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.
4. Dull Satin Finish: No. 6.

D. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL REPLICATION, GENERAL

A. Execution of the Work: In replicating historic items, disturb remaining existing work as minimally as possible and as follows:

1. Sequence work to minimize time before protective coatings are applied.
2. Replace or reproduce historic items where indicated or scheduled.
3. Make installation of replicated items reversible whenever possible.

B. Replicate Decorative Metal Item: Where indicated, duplicate existing items with new materials matching existing materials and features.

1. Design heavily deteriorated or missing features of decorative metal with compatible materials, using surviving prototypes to create patterns or molds for duplicating.
2. Do not use substitute materials unless otherwise indicated.
3. Compatible substitute materials may be used.

3.2 PROTECTIVE COATING

A. Protective Hot-Wax Coating: Apply wax coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being waxed.
2. Preheat surface to about 212 deg F (100 deg C); high enough to melt the wax and remove water vapor and other gases within metal surface, but not hot enough to boil the wax or ignite solvents, if any.
3. Apply uniform wax coating to surface, ensuring that wax coverage is complete, including recesses. Apply second wax coating following the same process.
4. Inspect surface and repair holidays by reheating and applying more wax.
5. Buff waxed surface to a slight shine with a lint-free cloth after wax has cooled to a hazy appearance.

B. Protective Organic Coating: Apply organic coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being coated.
2. Apply two uniform coats by air-spray method per manufacturer's written instructions, with interim drying between coats
3. Apply coating to a total dry film thickness of 1 mil (0.025 mm).
4. Protect coated surface from contamination until fully cured.

3.3 PLATING

A. Shop Plating: Disassemble item only as necessary for plating process.

1. Clean item to remove dirt, coatings, and corrosion.
2. Fill scratches, cracks, and depressions and polish or texturize metal surface to match the historic metal; prepare metal surfaces for plating.
3. Plate item to match approved mockup; assemble and install it.

3.4 INSTALLATION

A. Installing Railing and Fence Posts: After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup sloped away from post.

B. Anchoring Wood Rails: Secure wood rails to metal subrail or brackets from bottom of wood rail as indicated on Drawings. Make fastener heads flush to metal surface.

C. Installing Sealant: See Section 079200 "Joint Sealants."

3.5 HISTORIC DECORATIVE METAL SCHEDULE

A. Treatment of Decorative Railing and Handrail DMRH-1: Missing bronze railing and handrail.

1. Replicate entire, bronze railing and handrail with shop-fabricated assembly matching design of handrail assembly at location as directed.
2. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

END OF SECTION 050374

SECTION 050383 - HISTORIC CAST IRON REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of cast iron in the form of repair as follows:

1. Repairing cast iron and replacing damaged and missing components in place.
2. Removing and dismantling cast iron for shop repair and replacement of components; reinstalling repaired cast iron.
3. Reanchoring cast iron to building structure.
4. Installing wood rails or rails of other metals supported by or attached to cast-iron railings or brackets.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal.
2. Review methods and procedures related to historic cast-iron repair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: As directed For structural performance of repaired railings, handrail, brackets and anchors, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For post-installed structural anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic cast-iron repair specialist. Experience in repairing, brazing, and welding wrought iron, steel, or cuprous metals and installing and finishing new cast-iron work is insufficient experience for historic cast-iron repair work.

1. Historic Brazing-and-Welding Specialist: A qualified brazing-and-welding-repair specialist experienced with these repairs on historic cast iron. Have the brazing-and-welding specialist work under direction of the historic treatment specialist.
2. Historic Metal-Stitching Specialist: A qualified metal-stitching-repair specialist experienced with metal stitching of historic cast iron. Have the metal-stitching specialist work under direction of the historic treatment specialist.

B. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Repairing Metal Component: Two cast-iron pinning and metal-stitching repairs on sample pieces of cast iron.
2. Replacing Metal Component: Two cast-iron finials replaced on fence and wall registers.
3. Cast-Metal Components: Submit patterns, models, or plaster castings made from existing cast-iron item for each replacement casting required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: As directed Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, handrails, handrail brackets and anchors according to structural performance requirements.

B. Structural Performance: As directed Railings, handrails and handrail brackets, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METAL MATERIALS

A. Provide metal materials made of the alloys, forms, and types that match existing metals and that have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.3 WOOD MATERIALS

A. Wood Rails: Hardwood rails of species and profile indicated, with transparent finish, and prepared for securing to metal subrail or brackets as indicated on Drawings.

1. Species and Finish: As directed Match design reference sample, match existing, as indicated on Drawings, Ash, natural finish, Cherry, natural finish, Walnut, natural finish or White oak, light-stained finish.
2. Profile: As directed Match design reference sample, match existing, As indicated on Drawings or Round shape, 2-inch (50-mm) diameter.

B. Wood Rails: As directed Hardwood rails of species and profile matching design reference sample, matching existing, as indicated on Drawings, complying with Section 050372 "Historic Decorative Metal Repair", Section 060312 "Historic Wood Repair", Section 064013 "Exterior Architectural Woodwork" or Section 064023 "Interior Architectural Woodwork".

2.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Abrasive Materials:

1. Abrasive Pads: Non-scratch, of the following type(s):

    a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
    b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum-oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
3. Medium Abrasives for Copper-Alloys: Extra-fine bronze wool or plastic abrasive pads.

E. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.5 PINNING MATERIALS

A. Pins: Threaded, stainless-steel rod, cut to length as required for each repair.

B. Pinning Adhesive: Epoxy adhesive recommended in writing by adhesive manufacturer for bonding to cast iron.

2.6 METAL STITCHING MATERIALS

A. Stitching Pins: Threaded steel screws sized for the thickness and condition of cast iron being repaired, with thread design that pulls the sides of a crack together, thereby both sealing the crack and adding strength to the repair.

B. Locks: Multiple-dumbbell-shaped ties cut from steel sheet for installation in multiple thicknesses to add strength and distribute stresses in the cast iron as required for the thickness and condition of cast iron being repaired.

2.7 FASTENERS

A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting cast-iron components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method as directed.
3. As directed, for exposed fasteners, use slotted machine screws of hex-head profile or head profile flush with metal surface unless otherwise indicated or another head is required to match the existing fastening method as determined by Architect.
4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.

B. Post-Installed Structural Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: As directed Securing railings, handrails and handrail brackets to structure.
2. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor as directed.
3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Post-Installed Nonstructural Anchors: Fastener systems with bolt heads of same basic metal as fastened metal, if visible, unless otherwise indicated; with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Type: As directed Expansion anchor, adhesive anchor, types matching existing or types indicated on Drawings.
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.8 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling cast iron that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Brazing Rods for Cast Iron: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for strength and compatibility with cast-iron items.

C. Welding Electrodes and Filler Metal: Select according to AWS specifications for welding cast-iron; use compatible metal type and alloy as required for strength, and compatibility with cast-iron items.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.9 CAST-METAL FABRICATION

A. Custom fabricate repairs of cast-iron items and components in sizes and profiles to match existing cast iron unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

C. Comply with AWS for recommended practices in welding and brazing. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

D. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

1. Finish castings to match existing cast-iron work.
2. Replacement Casting for Handrail Bracket: Duplicate existing handrail bracket on the cast-iron railing of first-floor stairs in the lobby. Make molds from this bracket to create new cast-iron brackets.

2.10 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: As directed AAMA 611, Class I, 0.018 mm or Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish.

C. Color Anodic Finish: As directed AAMA 611, Class I, 0.018 mm, Class II, 0.010 mm or thicker over a satin (directionally textured), polished (buffed) or nonspecular as fabricated mechanical finish.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.11 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: As directed M21 (Mechanical Finish: buffed, smooth specular) or M22 (Mechanical Finish: buffed, specular).

C. Buffed Finish, Lacquered: M22 (Mechanical Finish: buffed, specular; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (Mechanical Finish: directionally textured, medium satin and hand-rubbed).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (Mechanical Finish: directionally textured, medium satin and hand-rubbed; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: As directed Match design reference sample, Match existing or Match Architect's sample.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: As directed Match design reference sample, Match existing or Match Architect's sample.

H. Patina Finish: As directed.

2.12 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed metal.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 HISTORIC CAST-IRON REPAIR, GENERAL

A. Execution of the Work: In repairing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize cast iron to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place unless otherwise indicated and retain as much original material as possible.
6. Replace or reproduce historic items where indicated or scheduled.
7. Make historic treatment of materials reversible whenever possible.
8. Install temporary protective measures to stabilize cast iron that is indicated to be repaired later.

B. Mechanical Coating Removal: Use gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as approved by Architect.

C. Repairing Cast-Iron Items: Match existing features, retaining as much original material as possible to complete the repair.

D. Replacing Cast-Iron Components: Where indicated, duplicate and replace items with new material matching existing.

1. Replace heavily deteriorated or missing parts or features of cast iron with compatible materials, using surviving prototypes to create patterns or molds for duplicate replacements.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work.

1. Brushes: If using wire brushes, use steel or stainless-steel brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    c. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: As directed Clean with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil and loose paint from joints and crevices.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied with sponges or wash cloths or low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. As directed Rinse with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray to remove detergent solution, soil, and loose paint.

D. Chemical Rust Removal:

1. Remove loose rust scale with approved, medium abrasives for ferrous metals.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.

6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

E. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 DISMANTLING, REPAIR, AND INSTALLATION

A. Repair cast iron in place insofar as practicable unless otherwise indicated. Where necessary, dismantle components from their substrate and repair and reinstall them.

B. Perform dismantling work as required in Section 024296 "Historic Removal and Dismantling."

C. Installation:

1. Locate and place cast-iron items level and plumb and in alignment with adjacent construction.

    a. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

2. Use concealed anchorages where possible unless otherwise indicated.
3. Form tight joints with exposed connections accurately fitted together.
4. Install concealed joint fillers, sealants, and flashings, as the Work progresses, to make exterior items weatherproof.
5. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
6. Touch Up: At completion of installation, touch up and restore damaged or defaced finish surfaces and fastener heads.

D. Reinstalling Railing and Fence Posts: After posts have been inserted in sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch (3-mm) buildup sloped away from post.

E. Anchoring Wood Rails: Secure wood rails to cast-iron subrail or brackets from bottom of rail as indicated on Drawings. Make fastener heads flush to metal surface of subrail or brackets.

F. Sealant: See Section 079200 "Joint Sealants."

3.4 FILLING DEFECTS IN PAINTED SURFACES

A. Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across as directed and all holes and tears by filling with metal-patching compound. Remove burrs. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

3.5 PINNING

A. Use cast-iron piece that has broken-off or a custom, cast replica of a similar item.

B. Grind mating surfaces of base metal and repair piece along the repair seam to produce an accurate fit and alignment with the base assembly. Grind mating surfaces to produce joint size no larger than 1/32 inch (0.8 mm).

C. Exposed Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/8-inch- (3-mm-) diameter, threaded stainless-steel pins set into 3/16-inch- (4.5-mm-) diameter holes drilled at through face of repair piece and into base metal. Insert pins at least 1 inch (25 mm) into base metal and 1 inch (25 mm) into repair piece with end countersunk at least 1/4 inch (6 mm) from exposed face of repair piece. For large pieces, center and space pins 3 inches (75 mm) apart and at least 1/4 inch (6 mm) from any edge.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/8-inch- (3-mm-) diameter, threaded stainless-steel pins set into aligned, 3/16-inch- (4.5-mm-) diameter holes drilled into base metal and into, but not through, the repair piece. Insert pins at least 1 inch (25 mm) into base metal and 1 inch (25 mm) into repair piece. For large pieces, center and space pins 3 inches (75 mm) apart and at least 1/4 inch (6 mm) from any edge.

E. Clean adhesive residue from exposed surfaces and fill exposed drill holes as specified in "Filling Defects in Painted Surfaces" Article.

3.6 METAL STITCHING

A. Install metal stitching materials according to written instructions of metal-stitching-system manufacturer for the thickness and condition of cast iron being repaired.

B. Drill, tap, and install metal stitching pins along entire length of crack being repaired, overlapping the pins to ensure complete sealing and pulling together of sides of the crack.

C. Cut slots shaped and sized to hold locks. Do not cut slots deeper than 90 percent of the thickness of the cast iron.

D. Grind off metal-stitching materials that project above surface of cast iron without damaging cast-iron surface.

3.7 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.8 HISTORIC CAST-IRON REPAIR SCHEDULE

A. Treatment of Cast-Iron Railing CIR-1: Cast-iron railing and gate.

1. Perform work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repairs: Repair broken railing finials by pinning, and replace missing components with custom, cast-iron or aluminum components as directed.
4. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting.".
5. Baked-Enamel or Powder-Coat Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
6. Gilding: As specified in Section 090398 "Historic Treatment of Gilding.".

B. Treatment of Cast-Iron Railing CIR-2: Cast-iron balustrade.

1. Perform work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Rust Removal: Chemical or Mechanical as directed.
4. Repair: Patch with new material by filling, metal stitching, or replacing cast-iron components with new castings and fasteners.
5. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting.".
6. Gilding: As specified in Section 090398 "Historic Treatment of Gilding.".

C. Treatment of Cast-Iron Railing and Handrail CIRH-1: Cast-iron railing with bronze handrail.

1. Perform work in the shop or in the field.
2. Cleaning: As specified in Section 050371 "Historic Decorative Metal Cleaning."
3. Repair: Patch cast iron with new material by filling, metal stitching, or replacing cast-iron components with new castings and fasteners.

    a. Replicate cast-iron as specified in Section 050374 "Historic Decorative Metal Replication."

4. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting".
5. Bronze Finish: Satin finish with statuary conversion coating on railing; satin hand-rubbed finish, lacquered, on handrail.

D. Treatment of Cast-Iron Facade and Storefront CIFS-#: Repair facade and storefront and replace missing components.

1. Perform work in the shop or in the field.
2. Dismantle and Salvage Items: Dismantle the following, return to shop to perform indicated treatment of item, and deliver to Owner for storage for future installation:

    a. Cast-iron medallions.
    b. Salvaged items as directed.

3. Cleaning: As specified in Section 050371 "Historic Decorative Metal Cleaning."
4. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning."
5. Rust Removal: As directed Chemical or Mechanical.
6. Repair: Patch with new material by filling, pinning pieces of broken ornaments, metal stitching cracks, or replacing cast-iron components with new castings and fasteners. Splice new material into deteriorated section, Reinforce, Refasten or Realign as directed.

    a. Replace with new duplicate of existing item.
    b. Replicate cast iron as specified in Section 050374 "Historic Decorative Metal Replication."
    c. Seal joints between components unless otherwise indicated; install sealant-type joints where indicated on Drawings.

7. Finish Treatment:

    a. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting."
    b. Gilding: As specified in Section 090398 "Historic Treatment of Gilding."

END OF SECTION 050383

SECTION 050385 - HISTORIC TREATMENT OF DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative formed metal as follows:

1. Stabilizing and protecting metal.
2. Repairing metal and replacing damaged and missing components in place.
3. Removing and dismantling metal for shop repair and replacement of components; reinstalling repaired metal.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090353 "Historic Treatment of Metal Ceilings" for repair and reconstruction of historic, stamped metal ceilings.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative formed metal.
2. Review methods and procedures related to historic treatment of decorative formed metal.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified, historic decorative formed metal repair specialist. Experience in installing and finishing new decorative formed metalwork is insufficient experience for historic treatment work on decorative formed metal.

B. Mockups: Prepare mockups of historic treatment repair processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Dent Removal: As directed Repair a kitchen backsplash, wall wainscoting, fascia, egg and dart molding, dentil molding, lion-head, pyramid and star component(s) of each type by pushing out dents from the back side or filling dents with sculpted metal-patching compound and flattening edges to align repaired components flush with adjacent work.
2. Replacing Components: As directed Replace a missing or excessively damaged kitchen backsplash, wall wainscoting, fascia, egg and dart molding, dentil molding, lion-head, pyramid and star component of each type with new or repaired, salvaged components and align edges of replacement components flush with adjacent work.
3. Stamped Metal Components: Submit patterns, models, or plaster castings made from existing decorative formed metal components for each replacement item required.

PART 2 - PRODUCTS

2.1 PREFABRICATED METAL PRODUCTS

A. Building Cornice: Factory-stamped and prefinished metal cornice assembly for the building facade Fabricate components that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: As directed Aluminum, aluminum-zinc alloy-coated steel, copper, tin-plated steel, zinc or zinc-coated (galvanized) steel; of thickness needed for component size and embossed design.
2. Size and Pattern(s): As directed Match existing, As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.
3. Exposed Finish: As directed Match design reference sample, Match existing, As indicated on Drawings, Bright mill finish, Antiqued, Primed for on-site painting, Powder coated with clear organic coating.

    a. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from full range of industry colors and color densities.

B. Wall-Cladding Panel: Factory-stamped and prefinished metal panels for kitchen backsplash, wall wainscoting or linear molding. Fabricate components that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: As directed Aluminum, aluminum-zinc alloy-coated steel, copper, tin-plated steel, zinc or zinc-coated (galvanized) steel; of thickness needed for panel size and embossed design.

2. Size: As directed Match existing, 24 by 24 inches (610 by 610 mm).
3. Pattern Type: As directed Match existing, Match Architect's samples or As selected by Architect from manufacturer's full range.
4. Exposed Finish: As directed Match design reference sample, Match existing, As indicated on Drawings, Bright mill finish, Antiqued, Primed for on-site painting, Powder coated with clear organic coating.

    a. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from full range of industry colors and color densities.

C. Stamped Detail: Factory-stamped and prefinished metal lion-head, pyramid and star panel(s) for application where indicated. Fabricate panels that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: As directed Aluminum, aluminum-zinc alloy-coated steel, copper, tin-plated steel, zinc or zinc-coated (galvanized) steel; of thickness needed for panel size and embossed design.
2. Panel Size: As directed 27 inches (686 mm) long or 48 inches (1219 mm) long, 12 inches (305 mm) across by 4 inches (102 mm) deep.
3. Exposed Finish: As directed Match design reference sample, Match existing, As indicated on Drawings, Bright mill finish, Antiqued, Primed for on-site painting, Powder coated with clear organic coating.

    a. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from full range of industry colors and color densities.

2.2 METAL MATERIALS

A. Provide metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.3 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

2.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Abrasive Materials:

1. Abrasive Pads: Non-scratch, of the following type(s):

a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum-oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
3. Medium Abrasives for Copper-Alloys: Extra-fine bronze wool or plastic abrasive pads.

E. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Fasteners shall be of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting decorative formed metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
4. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

B. Anchors to Building: Adhesive type, expansion type or types indicated on Drawings with bolt heads of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal anchored.

1. Strength: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M conducted by a qualified independent testing agency.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 METAL FABRICATION

A. Fabricate repairs of decorative formed metal items and components in sizes and profiles to match existing decorative formed metal unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Stamped components shall have embossed designs that are sharp and clear and shall be trimmed to exact size so that installed edges will be concealed or exposed as indicated on Drawings.

C. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

D. Comply with AWS for recommended practices in welding. Provide welds behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

2.7 ALUMINUM FINISHES

A. Mill finish.

B. Bright mill finish.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, applying, and baking finish.

2.8 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed historic metal.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish or Architect's sample, free of cross scratches as directed.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE FORMED METAL REPAIR, GENERAL

A. Execution of the Work: In repairing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize decorative formed metal to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place unless otherwise indicated, and retain as much original material as possible.
6. Replace or reproduce historic items where indicated or scheduled.
7. Make historic treatment of materials reversible whenever possible.
8. Install temporary protective measures to stabilize decorative formed metal that shall be repaired later.

B. Mechanical Coating Removal: Use only the gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as indicated as part of the historic treatment program and approved by Architect.

C. Repairing Decorative Formed Metal: Match existing materials and features, retaining as much original material as possible to complete the repair.

D. Replacing Decorative Formed Metal Components: Where indicated, duplicate and replace items with new metal, matching existing metal.

1. Replace heavily deteriorated or missing parts or features of decorative formed metal with compatible materials, using surviving prototypes to create patterns or dies for duplicate replacements.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work. Use only those methods indicated for each type of decorative formed metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

c. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: As directed Clean with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil and loose paint from joints and crevices. Leave uniform patina intact.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied with sponges or wash cloths or low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil and loose paint from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Leave uniform patina intact.
3. As directed Rinse with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray to remove detergent solution, soil, and loose paint.

D. Chemical Rust Removal:

1. Remove loose rust scale with approved, medium abrasives for ferrous metals.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean wash cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

E. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean wash cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 DISMANTLING, REPAIR, AND INSTALLATION

A. Repair decorative formed metal in place insofar as practicable unless otherwise indicated. Where necessary, dismantle components from their substrate and repair and reinstall them.

B. Perform dismantling work as required in Section 024296 "Historic Removal and Dismantling."

C. Deformed Components: Flatten bent and deformed components, so that embossed pattern along full length of the component's edges will again nest tightly against adjacent work insofar as practicable.

D. As directed effects in Painted Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound. Remove burrs. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

E. Installation:

1. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction.

    a. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

2. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
3. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
4. Install concealed joint fillers, sealants, and flashings, as the Work progresses, to make exterior items weatherproof.
5. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
6. Touch Up: At completion of installation, touch up and restore damaged or defaced finish surfaces and fastener heads.

F. Sealant: See Section 079200 "Joint Sealants."

3.4 PRIMING AND PAINTING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

C. Finish Painting: Apply as soon as possible after repair and installation according to applicable requirements in Section 090391 "Historic Treatment of Plain Painting.".

3.5 HISTORIC DECORATIVE FORMED METAL SCHEDULE

A. Treatment of Projecting Building Cornice MPBC-1:

1. Perform repair work in the shop or in the field.

2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning," except use no spray methods.
3. Rust Removal: As directed Chemical or Mechanical.
4. Repair: As directed Flatten deformed components, replace missing bracket with replicated, stamped detail and patch holes by filling with metal-patching compound.
5. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting."
6. Gilding: As specified in Section 090398 "Historic Treatment of Gilding."

B. Treatment of Wall Cladding WC-1:

1. Perform repair work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning," except use no spray methods.
3. Repair: As directed Flatten deformed panels, replace missing panels with replicated, stamped wainscoting panels and patch holes by filling with metal-patching compound.
4. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting."

C. Treatment of Stamped Detail SD-1:

1. Perform repair work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning," except use no spray methods.
3. Repair: As directed Flatten deformed panels and Patch holes by filling with metal-patching compound.
4. Replicate: Existing lion-head, pyramid or star ornament as directed.
5. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting."

    a. Color: As directed.

6. Patina Finish: As directed Repair missing patina spots or Repatinate entire unit to match existing as specified in Section 050373 "Historic Decorative Metal Refinishing."
7. Gilding: As specified in Section 090398 "Historic Treatment of Gilding."

END OF SECTION 050385

SECTION 050387 - HISTORIC TREATMENT OF METAL SCULPTURE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of metal sculpture as follows:

1. Repairing copper-alloy and cast-iron sculpture.
2. Replacing damaged and missing components.
3. Refinishing copper-alloy and cast-iron sculpture.
4. Removing and dismantling sculpture for shop repair and replacement of components; reinstalling repaired work.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of metal sculpture.
2. Review methods and procedures related to historic treatment of metal sculpture.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts, profiles, methods of attachment, accessory items, and finishes.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For repaired sculpture, its structural armature, and attachment to supporting construction, including analysis data signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For post-installed structural anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic metal-sculpture repair and finishing specialist experienced in the types of metal, repairs, and finishing required. Experience installing and finishing new metal sculpture is insufficient experience for historic treatment work on metal sculpture.

1. Historic Cast-Iron Brazing-and-Welding Specialist: A qualified brazing-and-welding-repair specialist experienced with these repairs on historic cast iron. Have the brazing-and-welding specialist work under direction of the historic treatment specialist.
2. Historic Metal-Stitching Specialist: A qualified metal-stitching-repair specialist experienced with metal stitching of historic cast iron. Have the metal-stitching specialist work under direction of the historic treatment specialist.

B. Mockups: Prepare mockups of historic treatment repair and finishing processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Repairing Metal Defect: As directed Repair a dent, crack, perforation or hole by filling with sculpted metal-patching compound to align repaired components flush with and following contour of adjacent work.
2. Pinning Metal Component: As directed Reattach a detached finger and missing star component of sculpture with new or repaired, salvaged component and align repair with adjacent work.
3. Stitching Metal Component: Repair a crack in cast iron by metal-stitching process.
4. Finishing Metal: As directed Refinish, repair finish or wax finish a cleaned area approximately 2 sq. ft. (0.2 sq. m) as indicated on drawings of bronze sculpture.
5. Cast-Metal Components: Submit patterns, models, or plaster castings made from existing metal-sculpture components for each replacement casting required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design the armature-repair for bronze sculpture and attachment to supporting construction according to structural performance requirements.

B. Structural Performance: Bronze sculpture, including attachment to supporting construction, shall withstand the effects of gravity loads, design wind loads, and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 100 lbf/sq. ft. (4.8 kN/sq. m) applied in any direction.
2. Concentrated load of 500 lbf (2.2 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Abrasive Materials:

1. Abrasive Pads: Non-scratch, of the following type(s):

   a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
   b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
3. Medium Abrasives for Copper Alloys: Extra-fine bronze wool or plastic abrasive pads.

F. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

G. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.3 METAL MATERIALS

A. Provide metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.4 PINNING MATERIALS

A. Pins: Threaded, stainless-steel rod, cut to length as required for each repair.

B. Pinning Adhesive: Epoxy adhesive recommended in writing by adhesive manufacturer for bonding to type of cast metal being pinned.

2.5 METAL-STITCHING MATERIALS

A. Stitching Pins: Threaded steel screws sized for the thickness and condition of cast iron being repaired, with thread design that pulls the sides of a crack together, thereby both sealing the crack and adding strength to the repair.

B. Locks: Multiple-dumbbell-shaped ties cut from steel sheet for installation in multiple thicknesses to add strength and distribute stresses in the cast iron as required for the thickness and condition of cast iron being repaired.

2.6 FASTENERS

A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use slotted machine screws of hex-head profile or head profile flush with metal surface unless otherwise indicated or another head is required to match the existing fastening method as determined by Architect.
4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.

B. Post-Installed Structural Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing sculpture to supporting construction.
2. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts as directed, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Post-Installed Nonstructural Anchors: Fastener systems with bolt heads of same basic metal as fastened metal, if visible, unless otherwise indicated; with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Type: As directed Expansion anchor, adhesive anchor, types matching existing or types indicated on drawings
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.7 PROTECTIVE COATING MATERIALS

A. Wax Coating: Inert, high-melting-point wax or wax blend, consisting primarily of carnauba or microcrystalline petroleum wax.

B. Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole UV inhibitor.

2.8 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin, metal-patching compound of color matching finish of base metal; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Brazing Rods: Type and alloy as recommended in writing by brazing-rod manufacturer and as required for color match, strength, and compatibility in fabricated items.

C. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as required for color match, strength, and compatibility in fabricated items.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.9 METAL FABRICATION

A. Custom fabricate replacement components in sizes and profiles to match existing metal sculpture unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

B. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.

C. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

D. Castings: Fabricate castings free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.10 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)."

B. Buffed Finish: M21 (buffed, smooth specular mechanical finish) or M22 (buffed, specular mechanical finish) as directed.

C. Buffed Finish, Lacquered: M22 (buffed, specular mechanical finish; specified clear organic coating).

D. Satin Hand-Rubbed Finish: M32-M34 (directionally textured, medium satin and hand-rubbed mechanical finishes).

E. Satin Hand-Rubbed Finish, Lacquered: M32-M34-06x (directionally textured, medium satin and hand-rubbed mechanical finishes; specified clear organic coating).

F. Satin Finish with Statuary Conversion Coating: M32-C55 (directionally textured, medium satin; sulfide conversion coating).

1. Color: As directed Match design reference sample, Match existing or Match Architect's sample.

G. Brushed Finish with Patina Conversion Coating: M35-C12-C52 (directionally textured, rotary brushed and buff polished, nonetched cleaned; ammonium sulfate conversion coating).

1. Texture and Color: Match design reference sample, Match existing or Match Architect's sample as directed.

H. Patina Finish: As directed.

2.11 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed historic metal.

PART 3 - EXECUTION

3.1 HISTORIC METAL-SCULPTURE TREATMENT, GENERAL

A. Execution of the Work: In treating historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize metal sculpture to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove dirt, deteriorated coatings, and corrosion.
3. Sequence work to minimize time before protective coatings are applied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair and finish items in place unless otherwise indicated and retain as much original material as possible.
6. Replace or reproduce historic finishes or components where indicated or scheduled.
7. Make treatment of materials reversible whenever possible.

B. Mechanical Coating Removal: Use only the gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as indicated as approved by Architect.

C. Repairing Metal Sculpture: Match existing materials and features, retaining as much original material as possible to complete the repair.

D. Replacing Metal-Sculpture Components: Where indicated, duplicate and replace items with new metal matching existing metal.

1. Replace heavily deteriorated or missing parts or features of metal sculpture with matching materials, using surviving prototypes to create patterns or dies for duplicate replacements.

E. Refinishing Metal Sculpture: Remove existing finish on sculpture unless otherwise indicated, including integral polished or patinated finish, and reapply it.

F. Repairing Finish of Metal Sculpture: Restore areas of deteriorated or missing finish on sculpture and blend restored finish with existing, adjacent finish, including integral polished or patinated finish.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: As directed Clean with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil from joints and crevices. Leave uniform patina intact.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied with sponges or wash cloths or low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Leave uniform patina intact.
3. As directed Rinse with cold or hot water applied with sponges or wash cloths, low-pressure spray or medium-pressure spray to remove detergent solution and soil.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. As directed wet surface with cold or hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer or established by mockup of two to three minutes as directed.
4. As directed Copper Alloys: Rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved, medium abrasives for ferrous metals.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.

3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 DISMANTLING, REPAIR, AND INSTALLATION

A. Repair sculpture in place so far as practicable unless otherwise indicated. Where necessary, dismantle sculpture and components from their substrate and repair and reinstall them.

B. Perform dismantling work as required in Section 024296 "Historic Removal and Dismantling."

C. Installation:

1. Locate and place sculpture level and plumb and in alignment with adjacent construction.
2. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
3. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
4. Touch up: At completion of installation, touch up and restore damaged or defaced finish surfaces and fastener heads.

D. Sealant: See Section 079200 "Joint Sealants."

3.4 FILLING DEFECTS IN SURFACES

A. As directed Repair non-load-bearing defects in existing copper-alloy and cast-iron surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound. Remove burrs. Prime cast-iron immediately after repair to prevent flash rusting.

3.5 PINNING

A. Use the metal piece that has broken off or a custom, cast replica of a similar item.

B. Grind mating surfaces of base metal and repair piece along the repair seam to produce an accurate fit and alignment with the base assembly. Grind mating surfaces to produce joint size no larger than 1/32 inch (0.8 mm).

C. Exposed Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/8-inch (3-mm) diameter, threaded stainless-steel pins set into 3/16-inch (4.5-mm) diameter holes drilled at through face of repair piece and into base metal. Insert pins at least 1 inch (25 mm) into base metal and 1 inch (25 mm) into repair piece with end countersunk at least 1/4 inch (6 mm) from exposed face of repair piece. For large pieces, center and space pins 3 inches (75 mm) apart and at least 1/4 inch (6 mm) from any edge.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/8-inch (3-mm) diameter, threaded stainless-steel pins set into aligned, 3/16-inch (4.5-mm) diameter holes drilled into base metal and into, but not through, the repair piece. Insert pins at least 1 inch (25 mm) into base metal and 1 inch (25 mm) into repair piece. For large pieces, center and space pins 3 inches (75 mm) apart and at least 1/4 inch (6 mm) from any edge.

E. Clean adhesive residue from exposed surfaces and fill exposed drill holes as specified in "Filling Defects in Surfaces" Article.

3.6 METAL STITCHING

A. Install metal-stitching materials according to written instructions of metal-stitching-system manufacturer for the thickness and condition of cast iron being repaired.

B. Drill, tap, and install metal-stitching pins along entire length of crack being repaired, overlapping the pins to ensure complete sealing and pulling together of sides of the crack.

C. Cut slots shaped and sized to hold locks. Do not cut slots deeper than 90 percent of the thickness of the cast iron.

D. Grind off metal-stitching materials that project above surface of cast iron without damaging the cast-iron surface.

3.7 PROTECTIVE COATING

A. Protective Hot-Wax Coating: Apply wax coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being waxed.
2. Preheat surface to about 212 deg F (100 deg C); hot enough to melt the wax and remove water vapor and other gases within metal surface, but not hot enough to boil the wax or ignite solvents, if any.
3. Apply uniform wax coating to surface, ensuring that wax coverage is complete, including recesses. Apply second wax coating following the same process.
4. Inspect surface and repair holidays by reheating and applying more wax.
5. Buff waxed surface to a slight shine with a lint-free cloth after wax has cooled to a hazy appearance.

B. Protective Organic Coating: Apply organic coating to produce uniform appearance without runs or other surface imperfections.

1. Clean and dry surface being coated.
2. Apply two uniform coats by air-spray method according to manufacturer's written instructions, with interim drying between coats.
3. Apply coating to a total dry film thickness of 1 mil (0.025 mm).
4. Protect coated surface from contamination until fully cured.

3.8 PRIMING AND PAINTING CAST-IRON SCULPTURE

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon as possible after cleaning.

C. Finish Painting: Apply as soon as possible after repair according to applicable requirements in Section 090391 "Historic Treatment of Plain Painting."

3.9 HISTORIC METAL-SCULPTURE SCHEDULE

A. Treatment of Bronze Statue Finish: Clean and repair patina finish and coat statue.

1. Perform work in the shop or in the field.
2. Cleaning: As directed Water cleaning, Detergent cleaning or Chemical cleaning.
3. Finish Repair: As directed Selectively patinate the nose, trident and previous metal repairs to match the rest of the statue.
4. Gilding: Restore gilding on trident fork as specified in Section 090398 "Historic Treatment of Gilding."
5. Protective Coating: Protective hot-wax or organic coating as directed.

B. Treatment of Cast-Iron Statue: Clean, repair patina or plated finish, and coat statue.

1. Perform work in the shop or in the field.
2. Cleaning: As directed Water cleaning, Detergent cleaning or Chemical cleaning.
3. Paint Removal: Remove paint only in vicinity of repairs. Remove paint as specified in Section 050371 "Historic Decorative Metal Cleaning."
4. Rust Removal: As directed Chemical or Mechanical.
5. Repair: Patch defects with sculpted metal-patching compound, pin-on piece of broken digit, and repair cracks by metal stitching as indicated on Drawings.
6. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting."
7. Gilding: As specified in Section 090393 "Historic Treatment of Gilding."

END OF SECTION 050387

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel
2. Grout

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Show fabrication of structural-steel components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator or testing agency as directed.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Source quality-control reports.

E. Field quality-control and special inspection reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Load and Resistance Factor Design; data are given at factored-load level. Allowable Stress Design; data are given at service-load level

B. Moment Connections: As directed Type PR, partially or Type FR, fully restrained.

C. Construction: As directed Moment frame, Braced frame, Shear wall system, Combined system of moment frame and braced frame, Combined system of moment frame and shear walls, Combined system of braced frame and shear walls or Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: As directed ASTM A992/A992M or ASTM A572/A572M, Grade 50 (345).

B. Channels, Angles, M, S-Shapes: As directed ASTM A36/A36M or ASTM A572/A572M, Grade 50 (345).

C. Plate and Bar: As directed ASTM A36/A36M or ASTM A572/A572M, Grade 50 (345).

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B or Grade C, structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1 (Type 10.9-1), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: As directed Hot-dip zinc coating, Mechanically deposited zinc coating or Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating or mechanically deposited zinc coating, baked epoxy-coated finish as directed.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: As directed ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.

1. Finish: As directed Plain or Mechanically deposited zinc coating.

E. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: As directed ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable.

1. Configuration: As directed Straight or Hooked.
2. Finish: As directed Plain, Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

G. Headed Anchor Rods: As directed ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable, straight.

1. Finish: As directed Plain, Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

H. Threaded Rods: As directed ASTM A36/A36M or ASTM A193/A193M, Grade B7.

1. Finish: As directed Plain, Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035.

2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting", Section 099600 "High-Performance Coatings" or Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Primer: As directed SSPC-Paint 25, Type I or Type II, zinc oxide, alkyd, linseed oil primer.

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As directed Snug tightened, Pretensioned or Slip critical.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E165.
2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E164.
4. Radiographic Inspection: ASTM E94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. As directed Snug-tighten or Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As directed Snug tightened, Pretensioned or Slip critical.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: As directed Owner will engage or Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94.

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

1.3 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.

1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.

B. Samples: Submit Samples to set quality standards for AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld and with weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld and with weld ground smooth and blended.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category ACSE or Category CSE as directed, and is experienced in erecting AESS similar to that indicated on this Project.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, Endorsement P2 or Endorsement P3 or SSPC-QP 3 as directed.

D. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.

1. Build mockup of typical portion of AESS as shown on Drawings.
2. Coordinate painting requirements with Section 099113 "Exterior Painting" or Section 099123 "Interior Painting" as directed
3. Coordinate high-performance coatings requirements with Section 099600 "High-Performance Coatings."
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.

1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting", Section 099600 "High-Performance Coatings", Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings" as directed.

B. Galvanized Steel Primer: As directed MPI#26, MPI#80 or MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 or ASTM A780/A780M as directed.

2.4 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

B. Category AESS 1:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.

C. Category AESS 2: In addition to requirements for Category AESS 1, comply with the following:

1. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
2. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
3. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
4. Conceal fabrication and erection markings from view in the completed structure.
5. Make welds uniform and smooth.

D. Category AESS 3: In addition to requirements for Category AESS 1 and AESS 2, comply with the following:

1. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
2. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
3. Orient HSS seams as indicated or away from view.
4. Align and match abutting member cross sections.
5. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
6. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.

E. Category AESS 4: In addition to requirements for Category AESS 1, AESS 2, and AESS 3, comply with the following:

1. Treat HSS seams to appear seamless.
2. Contour and blend welds and weld transitions between members, removing splatter exposed to view.
3. Fill surface imperfections with filler and sand smooth to achieve surface quality approved by Architect.
4. Minimize weld show-through and distortion on the opposite side of exposed connections by grinding to a smooth profile aligned with adjacent material.

F. Erection marks, painted marks, and other marks are permitted on galvanized or corrosion-resisting (weathering) steel surfaces of completed structure as directed.

G. Cleaning Corrosion-Resisting (Weathering) AESS: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6 (WAB)/NACE WAB-3.

2.5 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Corrosion-resisting (weathering) steel surfaces.
5. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 7 (WAB)/NACE WAB-4.
2. SSPC-SP 14 (WAB)/NACE WAB-8.
3. SSPC-SP 11.
4. SSPC-SP 6 (WAB)/NACE WAB-3.
5. SSPC-SP 10 (WAB)/NACE WAB-2.
6. SSPC-SP 5 (WAB)/NACE WAB-1.

C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.

1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
2. Grind tack welds smooth.
3. Remove backing and runoff tabs, and grind welds smooth.
4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
5. Remove erection bolts in Category AESS 4 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
6. Fill weld access holes in Category AESS 4 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
7. Conceal fabrication and erection markings from view in the completed structure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.5 PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

END OF SECTION 051213

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. K-series steel joist substitutes.
3. LH- and DLH-series long-span steel joists.
4. Joist girders.
5. Joist accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer certificates.

C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

2.5 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated.

2.6 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

B. Primer: As directed Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting", or Section 099600 "High-Performance Coatings."

2.7 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications", " and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice." Furnish additional erection bridging if required for stability.

D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.

E. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: As directed Plain, Hot-dip zinc coating, ASTM A153/A153M, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

B. Apply one coat of shop primer to joists and joist accessories.

C. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings" as directed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.
3. Noncomposite form deck.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Evaluation reports.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: As directed ASTM A1008/A1008M, Structural Steel (SS), Grade 33 (230), Grade 40 (275) or Grade 80 (550) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: As directed Manufacturer's standard, Gray, White, Gray top surface with white underside.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), Grade 40 (275), Grade 80 (550), G60 (Z180) or G90 (Z275) zinc coating as directed.
3. Galvanized and Shop-Primed Steel Sheet: As directed ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), Grade 40 (275), Grade 80 (550), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: As directed Manufacturer's standard, Gray, White or Gray top surface with white underside.

4. Deck Profile: As indicated Type NR, narrow rib, Type IR, intermediate rib, Type WR, wide rib, Type 3DR, deep rib or Long span.
5. Profile Depth: As indicated 1-1/2 inches (38 mm), 2 inches (51 mm), 3 inches (76 mm), 4-1/2 inches (114 mm), 6 inches (152 mm) or 7-1/2 inches (190 mm).
6. Design Uncoated-Steel Thickness: As indicated 0.0295 inch (0.75 mm), 0.0358 inch (0.91 mm), 0.0474 inch (1.20 mm), 0.0598 inch (1.52 mm) or 0.0747 inch (1.90 mm).

2.3 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 (230), Grade 40 (275) or Grade 80 (550) minimum as directed, with top surface

phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer as directed.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G30 (Z90), G60 (Z180) or G90 (Z275) zinc coating as directed.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G30 (Z90) or G60 (Z180) zinc coating as directed; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray or white baked-on, rust-inhibitive primer as directed.
4. Profile Depth: 1-1/2 inches (38 mm), 2 inches (51 mm) or 3 inches (76 mm) As indicated.
5. Design Uncoated-Steel Thickness: As directed 0.0295 inch (0.75 mm), 0.0358 inch (0.91 mm), 0.0474 inch (1.20 mm) or 0.0598 inch (1.52 mm).

2.4 NONCOMPOSITE FORM DECK

A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Uncoated Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 (230), Grade 40 (275) or Grade 80 (550) minimum as directed.
2. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 (230), Grade 40 (275) or Grade 80 (550) minimum as directed, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Manufacturer's standard, Gray, White or Gray top surface with white underside as directed.

3. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), Grade 40 (275), Grade 80 (550), G30 (Z90), G60 (Z180) or G90 (Z275) zinc coating as directed.
4. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230) or Grade 80 (550), G60 (Z180) zinc coating as directed; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: As directed Manufacturer's standard, Gray, White or Gray top surface with white underside.

5. Profile Depth: As directed 9/16 inch (14 mm), 15/16 inch (24 mm), 1-5/16 inches (33 mm) or 1-1/2 inches (38 mm).
6. Design Uncoated-Steel Thickness: As directed 0.0149 inch (0.38 mm), 0.0179 inch (0.45 mm), 0.0239 inch (0.61 mm), 0.0295 inch (0.75 mm), 0.0358 inch (0.91 mm), 0.0474 inch (1.20 mm) or 0.0598 inch (1.52 mm).

2.5 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

G. Galvanizing Repair Paint: As directed ASTM A780/A780M or SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck as directed. Space welds or mechanical fasteners not more than 12 inches (305 mm) apart with at least one weld or fastener at each corner as directed.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

I. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

J. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.3 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces or top surface as directed of prime-painted deck immediately after installation and apply repair paint.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Product test reports.

D. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and two Family Dwellings."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H (ST230H) or ST50H (ST340H) As required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90), G90 (Z275) or equivalent.

B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As directed 33 (230) or 50 (340), Class 1 As required by structural performance.
2. Coating: As directed G60 (Z180) or G90 (Z275).

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As directed 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm).
2. Flange Width: As directed 1-3/8 inches (35 mm), 1-5/8 inches (41 mm), 2 inches (51 mm) or 2-1/2 inches (63 mm).
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and matching minimum base-metal thickness of steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As directed 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm).
2. Flange Width: As directed 1-3/8 inches (35 mm), 1-5/8 inches (41 mm), 2 inches (51 mm) or 2-1/2 inches (63 mm).
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As directed 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm).
2. Flange Width: As directed 1-3/8 inches (35 mm), 1-5/8 inches (41 mm), 2 inches (51 mm) or 2-1/2 inches (63 mm).
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips: As directed Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As directed 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm).
2. Flange Width: As directed 1-3/8 inches (35 mm), 1-5/8 inches (41 mm), 2 inches (51 mm) or 2-1/2 inches (63 mm).
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips: As directed Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: As directed ASTM F1554, Grade 36, Grade 55, threaded carbon-steel hex-headed bolts, headless, hooked bolts, headless bolts, with encased end threaded, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C or mechanically deposition according to ASTM B695, Class 50.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design

load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: As directed Torque-controlled expansion anchor, Torque-controlled adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: As directed ASTM A780/A780M, MIL-P-21035B or SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As directed 24 inches (610 mm), 32 inches (813 mm), To match stud spacing As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3 mm) between the end of wall-framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As directed 12 inches (305 mm), 16 inches (406 mm), 19.2 inches (488 mm), 24 inches (610 mm) or As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches (1220 mm) as indicated on Drawings or as indicated on Shop Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As directed 12 inches (305 mm), 16 inches (406 mm), 19.2 inches (488 mm), 24 inches (610 mm) or As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) or 18 inches (450 mm) of single deflection track as directed. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at 96-inch (2440-mm) centers, centers indicated, centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As directed 12 inches (305 mm), 16 inches (406 mm), 19.2 inches (488 mm), 24 inches (610 mm) or As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) or 18 inches (450 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at 96-inch (2440-mm) centers, centers indicated or centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

END OF SECTION 054000

SECTION 054400 - COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cold-formed steel framing in the form of the following:

1. Cold-formed steel trusses for roofs.
2. Cold-formed steel trusses for floors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel trusses.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

C. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:

a. Floor Trusses: Vertical deflection of 1/480 for live loads and l/360 for total loads of the span.
b. Roof Trusses: Vertical deflection of 1/240 or 1/360 of the span as directed.
c. Scissor Roof Trusses: Horizontal deflection of 1-1/4 inches (32 mm) at reactions.

3. Design trusses to provide for movement of truss members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses shall comply with the following:

1. Floor and Roof Systems: AISI S210.
2. Lateral Design: AISI S213.
3. Roof Trusses: AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As directed ST33H (ST230H), ST50H (ST340H) As required by structural performance.
2. Coating: As directed G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90), G90 (Z275) or equivalent.

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard C-shaped steel sections.

1. Connecting Flange Width: 1-5/8 inches (41 mm), minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm) as directed.
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

2.5 FLOOR TRUSSES

A. Floor Truss Members: Manufacturer's standard C-shaped steel sections.

1. Connecting Flange Width: 1-5/8 inches (41 mm), minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: As directed 0.0329 inch (0.84 mm), 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm) or 0.0966 inch (2.45 mm).
3. Section Properties: As directed minimum allowable calculated section modulus, moment of inertia, and allowable moment.

2.6 TRUSS ACCESSORIES

A. Fabricate steel-truss accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: As directed ASTM F1554, Grade 36, Grade 55, threaded carbon-steel hex-headed bolts, headless, hooked bolts, headless bolts, with encased end threaded, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C mechanical deposition according to ASTM B695, Class 50.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design

load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel trusses to structure.
2. Type: As directed Torque-controlled expansion anchor, Torque-controlled adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Power-Actuated Fasteners: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: As directed ASTM A780/A780M, MIL-P-21035B or SSPC-Paint 20.

B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.2 INSTALLATION

A. Install bridge and brace cold-formed steel trusses according to AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.

1. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure.
2. Install continuous bridging and permanently brace trusses as indicated on Drawings. As indicated on Shop Drawings and designed according to CFSEI's Technical Note 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses.".

B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.

C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.

D. Truss Spacing: As directed 16 inches (406 mm), 19.2 inches (488 mm), 24 inches (610 mm), 32 inches (813 mm), 48 inches (1220 mm) As indicated on Drawings.

3.3 ERECTION TOLERANCES

A. Install cold-formed steel trusses level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual trusses no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: As directed Owner will engage or Engage a qualified special inspector to perform inspections.

B. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

C. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Prefabricated building columns.
3. Shelf angles.
4. Metal ladders.
5. Ladder safety cages.
6. Metal floor plate and supports.
7. Elevator pit sump covers.
8. Structural-steel door frames.
9. Miscellaneous steel trim.
10. Metal bollards.
11. Wire rope parking garage guards.
12. Pipe Downspout guards.
13. Abrasive metal nosings, treads and thresholds.
14. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Prefabricated building columns.
2. Metal nosings and treads.
3. Paint products.
4. Grout.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

D. Samples for Verification: For each type and finish of extruded nosing and tread.

E. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless-Steel Bars and Shapes: ASTM A276, Type 304 or Type 316L as directed.

D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

E. Rolled-Stainless-Steel Floor Plate: ASTM A793.

F. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

G. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

H. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

I. Zinc-Coated Steel Wire Rope: ASTM A741.

1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm) As indicated.
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B or structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm), 0.079-inch (2-mm) or 0.064-inch (1.6-mm) nominal thickness as directed.
3. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B, structural steel, Grade 33 (Grade 230); 0.0966-inch (2.5-mm) 0.0677-inch (1.7-mm), 0.0528-inch (1.35-mm) minimum thickness; unfinished coated with rust-inhibitive, baked-on, acrylic enamel, hot-dip galvanized after fabrication as directed.

K. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

L. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

M. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

N. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

O. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

P. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

Q. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors as directed.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts as directed, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting", Section 099123 Interior Painting", Section 099600 "High-Performance Coatings", Section 099113 "Exterior Painting," Section 099123 Interior Painting," and Section 099600 "High-Performance Coatings" as directed

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.

D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

2.7 PREFABRICATED BUILDING COLUMNS

A. General: Provide prefabricated building columns consisting of load-bearing structural-steel members protected by concrete fireproofing encased in an outer non-load-bearing steel shell. Fabricate connections to comply with details shown or as needed to suit type of structure indicated.

B. Fire-Resistance Ratings: Provide prefabricated building columns listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing according to ASTM E119.

1. Fire-Resistance Rating: 4 hours, 3 hours, 2 hours or as indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings"

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches (406 mm) or 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) or 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges as directed.
3. Rungs: 3/4-inch- (19-mm-) diameter, 3/4-inch- (19-mm-) square, 1-inch- (25-mm-) diameter or 1-inch- (25-mm-) square steel bars as directed.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung.
6. Galvanize exterior ladders, including brackets.
7. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

C. Aluminum Ladders:

1. Space siderails 16 inches (406 mm) or 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.

3. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.

2.10 LADDER SAFETY CAGES

A. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.

B. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.

C. Galvanize steel ladder safety cages, including brackets and fasteners.

D. Prime steel ladder safety cages, including brackets and fasteners, with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.11 METAL FLOOR PLATE

A. As directed Fabricate from rolled-steel floor, rolled-stainless-steel floor, rolled-aluminum-alloy tread or abrasive-surface floor plate of thickness indicated below:

1. Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), 1/4 inch (6.4 mm), 5/16 inch (8 mm), 3/8 inch (9.5 mm) or As indicated.

B. Provide steel, stainless-steel or aluminum angle supports as indicated.

C. As directed provide flush steel, stainless-steel or aluminum bar drop handles for lifting removable sections, one at each end of each section.

2.12 ELEVATOR PIT SUMP COVERS

A. As directed fabricate from 1/8-inch (3.2-mm) or 3/16-inch (4.8-mm) rolled-steel floor or abrasive-surface floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

2.13 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel stops. Plug-weld built-up members and continuously weld exposed joints. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Galvanize exterior steel frames.

C. Prime exterior steel frames with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.14 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.15 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe or Schedule 80 steel pipe 1/4-inch (6.4-mm) wall-thickness rectangular steel tubing or steel shapes, as indicated.

1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.

B. Fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.

C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve.

D. Prime bollards with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.16 WIRE ROPE PARKING GARAGE GUARDS

A. Wire Rope Parking Garage Guards: 3/4-inch- (19-mm-) diameter, zinc-coated steel wire ropes with wire rope fittings for securing to parking garage columns and walls and for tightening wire rope.

2.17 PIPE DOWNSPOUT GUARDS

A. Fabricate pipe downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.

B. Galvanize pipe downspout guards.

C. Prime pipe downspout guards with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.18 ABRASIVE METAL NOSINGS TREADS AND THRESHOLDS

A. Cast-Metal Units: As directed Cast iron, aluminum, bronze (leaded red or semired brass) or nickel silver (leaded nickel bronze), with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

B. Extruded Units: As directed Aluminum or Bronze, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder.
   1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
   2. Provide solid-abrasive-type units without ribs.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c.

E. Apply bituminous paint to concealed surfaces of cast-metal units.

F. Apply clear lacquer to concealed surfaces of extruded units.

2.19 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.20 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Galvanize loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer. Primer specified in Section 099600 "High-Performance Coatings."

2.21 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.22 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.23 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer, primers specified in Section 099113 "Exterior Painting", primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is primers specified in Section 099600 "High-Performance Coatings" are indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" or SSPC-SP 3, "Power Tool Cleaning" requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards to existing construction with expansion anchors, anchor bolts or through bolts as directed. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.

C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete in formed or core-drilled holes. Fill annular space around bollard solidly with nonshrink grout.

D. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

E. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled precast concrete treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Woven-wire mesh.
2. Welded-wire mesh.
3. Prefilled metal-pan-stair treads.
4. Abrasive nosings.
5. Shop primer products.
6. Nonslip-aggregate concrete finish.
7. Precast concrete treads.
8. Handrail wall brackets.
9. Grout.

B. Sustainable Design Submittals:

1. As directed

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed for professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction or State in which Project is located.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

   a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: As directed.

2.2 METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Tubing for Railings: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
1. Provide galvanized finish for exterior installations and where indicated.

C. Steel Pipe for Railings: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish for exterior installations and where indicated.

D. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

E. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

F. Expanded-Metal, Carbon Steel: ASTM F1267, Type I (expanded) or Type II (expanded and flattened), Class 1 (uncoated) as directed.
1. Style Designation: 3/4 number 13 or 1-1/2 number 10 as directed.

G. Woven-Wire Mesh: As directed Intermediate-crimp, diamond or square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

H. Woven-Wire Mesh: As directed Intermediate-crimp, diamond or square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch- (4.1-mm-) diameter, aluminum wire complying with ASTM B211 (ASTM B211M), Alloy 6061-T94.

I. Welded-Wire Mesh: As directed Diamond or Square pattern, 2-inch (50-mm) welded-wire mesh, made from 0.236-inch (6.0-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

J. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

K. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

L. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

M. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

N. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

O. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 ABRASIVE NOSINGS

A. Cast-Metal Units: As directed cast iron, aluminum, bronze or nickel silver, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
   1. Configuration: Cross-hatched units, 3 inches (75 mm) or 4 inches (100 mm) wide without lip as directed.

B. Extruded Units: As directed Aluminum or Bronze units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
   1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
   2. Provide solid-abrasive units without ribs.
   3. Nosings: Square-back units, 1-7/8 inches (48 mm), 3 inches (75 mm) or 4 inches (100 mm) wide, without lip as directed.
   4. Nosings: Two-piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete.

C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

D. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

E. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.4 FASTENERS

A. General: As directed Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

   1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts as directed, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.5 MISCELLANEOUS MATERIALS

A. Handrail Wall Brackets: As directed Cast nickel-silver, Cast aluminum, Cast bronze, Cast stainless steel, center of rail 2-1/2 inches (63.5 mm) or 3-1/8 inches (79.4 mm) from face of wall.

B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: As directed Comply with SSPC-Paint 20, Type I-A, Type I-B, Type I-C or Type II, Level 1, 2 or 3, and compatible with topcoat.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior or exterior use as directed; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

G. Prefilled Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa) and maximum aggregate size of 1/2 inch (13 mm) unless otherwise indicated.
2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, or galvanized steel, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.

4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

    a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

5. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.6 PRECAST CONCRETE TREADS

A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.

B. Reinforcement: Galvanized, welded-wire reinforcement, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter steel wire; comply with ASTM A1064/A1064M, except for minimum wire size.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs and railings in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint, Finish #2 - Completely sanded joint with some undercutting and pinholes okay, Finish # 3 - Partially dressed weld with spatter removed or Finish # 4 - Good quality, uniform undressed weld with minimal splatter as directed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.8 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural, Commercial or Service Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or steel channels or steel rectangular tubes as indicated on Drawings.

   a. Stringer Size: As required to comply with "Performance Requirements" Article As indicated on Drawings.
   b. Provide closures for exposed ends of channel and rectangular tube stringers.
   c. Finish: Shop primed or Painted as directed.

2. Construct platforms of steel plate or channel or rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article indicated on Drawings.

   a. Provide closures for exposed ends of channel and rectangular tube framing.
   b. Finish: Shop primed or Painted as directed.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

   a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).

1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
2. Steel Sheet: Uncoated, cold or hot-rolled steel sheet unless otherwise indicated.
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Shape metal pans to include nosing integral with riser.
6. Attach abrasive nosings to risers.
7. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
8. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.9 FABRICATION OF STAIR RAILINGS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings." Section 057300 "Decorative Metal Railings."

B. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: As directed 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
2. Picket Infill: As directed 1/2-inch- (13-mm-) or 3/4-inch- (19-mm-) round or square pickets spaced less than 4 inches (100 mm) clear.
3. Expanded-Metal Infill: Expanded-metal panels edged with U-shaped channels made from steel sheet and not less than 0.043 inch (1.1 mm) thick. Orient expanded metal with long dimension of diamonds parallel to top rail or perpendicular to top rail or vertical as directed.
4. Mesh Infill: As directed Woven or Welded-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) steel channel frames. Orient wire mesh with diamonds vertical, wires perpendicular and parallel to top rail or wires horizontal and vertical as directed.
5. Intermediate Rails Infill: 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square intermediate rails spaced less than 12 inches (305 mm) or 21 inches (533 mm) clear.

C. Welded Connections: Fabricate railings with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint, Finish #2 - Completely sanded joint, some undercutting and pinholes are okay, Finish #3 - Partially dressed weld with spatter removed or Finish #4 - Good quality, uniform undressed weld with minimal splatter as shown in NAAMM AMP 521 as directed.

D. Form changes in direction of railings as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. By inserting prefabricated elbow fittings, flush-elbow fittings or elbow fittings of radius indicated as directed.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. Provide ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
3. As directed Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.10 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete.
2. Center nosings on tread width.

G. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
4. Secure posts and rail ends to building construction as follows:

    a. As directed Anchor posts to steel by welding or bolting to steel supporting members.
    b. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

3.3 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and

Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

END OF SECTION 055113

SECTION 055116 - METAL FLOOR PLATE STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Industrial Class stairs with steel floor plate treads.
2. Steel railings attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

1.3 ACTION SUBMITTALS

A. Product Data: For metal floor plate stairs and the following:

1. Metal floor plate treads.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Shop primer products.
5. Grout.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed for professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction or State in which Project is located.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360.

C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: As directed.

2.2 METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Tubing for Railings: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
   1. Provide galvanized finish for exterior installations and where indicated.

D. Steel Pipe for Railings: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

E. Woven-Wire Mesh: As directed Intermediate-crimp, diamond or square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

F. Welded-Wire Mesh: As directed Diamond or Square pattern, 2-inch (50-mm) welded-wire mesh, made from 0.236-inch (6.0-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

G. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

A. General: As directed Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5, Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

   1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: As directed Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: As directed Comply with SSPC-Paint 20, Type I-A, Type I-B, Type I-C or Type II, Level 1, 2 or 3, and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: As directed High-zinc-dust-content paint complying with SSPC-Paint 20 or ASTM A780/A780M and compatible with paints specified to be used over it.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior or exterior use as directed; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs and railings in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed or Finish #4 - Good quality, uniform undressed weld with minimal splatter.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

a. Stringer Size: As required to comply with "Performance Requirements" Article or As indicated on Drawings.
b. Provide closures for exposed ends of channel stringers.
c. Finish: As directed Shop primed, Painted or Galvanized.

2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article or indicated on Drawings.

a. Provide closures for exposed ends of channel framing.
b. Finish: As directed Shop primed, Painted or Galvanized as directed.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from rolled-steel floor plate of thickness needed to comply with performance requirements, but not less than 1/4 inch (6.4 mm), needed to comply with performance requirements, but not less than 3/16 inch (4.8 mm), needed to comply with performance requirements, but not less than 1/8 inch (3.2 mm) or indicated on Drawings.

1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
2. Form treads with integral nosing and back edge stiffener. Form risers from steel sheet not less than 0.097 inch (2.5 mm) thick, welded to tread nosings and stiffeners and to platforms.
3. Form treads with integral nosing and back edge stiffener and with open risers.
4. Weld steel supporting brackets to stringers and weld treads to brackets.
5. Fabricate platforms with integral nosings matching treads and weld to platform framing.
6. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

D. Risers: As directed Open or Solid.

E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

1. Material and Finish: Match treads and platforms.
2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

B. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
2. Picket Infill: 1/2-inch- (13-mm-), 3/4-inch- (19-mm-) round or square pickets spaced less than 4 inches (100 mm) clear.
3. Mesh Infill: As directed Woven or Welded-wire mesh crimped or welded into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) steel channel frames. Orient wire mesh with diamonds vertical, wires perpendicular and parallel to top rail or wires horizontal and vertical.
4. Intermediate Rails Infill: 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square intermediate rails spaced less than 12 inches (305 mm) or 21 inches (533 mm) clear.

C. Welded Connections: Fabricate railings with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. As directed Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed or Finish #4 - Good quality, uniform undressed weld with minimal splatter as shown in NAAMM AMP 521.

D. Form changes in direction of railings as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. By inserting prefabricated elbow fittings, flush-elbow fittings or elbow fittings of radius indicated as directed.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.

1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. As directed Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning" minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLING METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.

a. Clean bottom surface of baseplates.
b. Set steel stair baseplates on wedges, shims, or leveling nuts.
c. After stairs have been positioned and aligned, tighten anchor bolts.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
4. Secure posts and rail ends to building construction as follows:

a. Anchor posts to steel by welding or bolting to steel supporting members.
b. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

2. Secure wall brackets to building construction as required to comply with performance requirements.

3.3 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055116

SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Industrial Class stairs with steel-grating treads.
2. Steel railings attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

1.3 ACTION SUBMITTALS

A. Product Data: For metal grating stairs and the following:

1. Gratings.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Shop primer products.
5. Grout.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction or State in which Project is located.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360.

C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: As directed.

2.2 METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

D. Steel Wire Rod for Grating Crossbars: ASTM A510/A510M.

E. Aluminum Bars for Grating Treads: ASTM B221 (ASTM B221M) extruded aluminum, alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
2. 6061-T1, for grating crossbars.

F. Steel Tubing for Railings: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
1. Provide galvanized finish for exterior installations and where indicated.

G. Steel Pipe for Railings: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

H. Provide galvanized finish for exterior installations and where indicated.

I. Woven-Wire Mesh: Intermediate-crimp, diamond or square pattern as directed, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

J. Welded-Wire Mesh: As directed Diamond or Square pattern, 2-inch (50-mm) welded-wire mesh, made from 0.236-inch (6.0-mm) nominal-diameter steel wire complying with ASTM A510/A510M.

K. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

L. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

A. General: As directed Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 or Type 304

stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: As directed Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting", Section 099600 "High-Performance Coatings", Section 099113, "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: As directed Comply with SSPC-Paint 20, Type I-A, Type I-B, Type I-C or Type II, Level 1, 2 or 3, and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: As directed High-zinc-dust-content paint complying with SSPC-Paint 20 or ASTM A780/A780M and compatible with paints specified to be used over it.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior or exterior use as directed; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs and railings in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed or Finish #4 - Good quality, uniform undressed weld with minimal splatter as directed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that are exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

    a. Stringer Size: As required to comply with "Performance Requirements" Article or As indicated on Drawings.
    b. Provide closures for exposed ends of channel stringers.
    c. Finish: As directed Shop primed, Painted or Galvanized.

2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article or indicated on Drawings.

    a. Provide closures for exposed ends of channel framing.
    b. Finish: As directed Shop primed, Painted or Galvanized.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

    a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. As directed Fabricate treads and platforms from welded steel or pressure-locked steel or pressure-locked aluminum grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c., 1-by-3/16-inch (25-by-5-mm) bearing bars at 11/16 inch (17 mm) o.c., 1-by-1/8-inch (25-by-3-mm) bearing bars at 7/16 inch (11 mm) o.c. and crossbars at 4 inches (100 mm) o.c.
2. As directed Fabricate treads and platforms from welded steel or pressure-locked steel or pressure-locked aluminum grating with openings in gratings no more than 5/16 inch (8 mm), 1/2 inch (12 mm), 3/4 inch (19 mm) or 1 inch (25 mm) in least dimension.

    a. Surface: As directed Plain or Serrated.
    b. Finish: As directed Shop primed, Painted, Galvanized or Mill.

3. Fabricate grating treads with rolled-steel floor plate or cast-abrasive nosing as directed and with steel angle or steel plate carrier at each end for stringer connections.

    a. Secure treads to stringers with bolts.

4. Fabricate grating platforms with nosing matching that on grating treads.

    a. Secure grating to platform framing by welding with bolts.

D. Risers: As directed Open or Solid.

E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

1. Material and Finish: Steel plate to match finish of other steel items.
2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

B. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: As directed 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
2. Picket Infill: As directed 1/2-inch- (13-mm) or 3/4-inch (19-mm) round or square pickets spaced less than 4 inches (100 mm) clear.
3. Mesh Infill: As directed Woven or Welded-wire mesh crimped or welded into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) steel channel frames. Orient wire mesh with diamonds vertical, wires perpendicular and parallel to top rail or wires horizontal and vertical as directed.
4. Intermediate Rails Infill: As directed 1-5/8-inch- (41-mm-) diameter or 1-1/2-inch- (38-mm-) square intermediate rails spaced less than 12 inches (305 mm) or 21 inches (533 mm) clear.

C. Welded Connections: Fabricate railings with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

    a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. As directed Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed or Finish #4 - Good quality, uniform undressed weld with minimal splatter as shown in NAAMM AMP 521.

D. Form changes in direction of railings as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

5. As directed inserting prefabricated elbow fittings, flush-elbow fittings or elbow fittings of radius indicated.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.

1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. as directed Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning", SSPC-SP 3, "Power Tool Cleaning" or minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLING METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces.

a. Clean bottom surface of baseplates.
b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
c. After stairs have been positioned and aligned, tighten anchor bolts.
d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
4. Secure posts and rail ends to building construction as follows:

    a. Anchor posts to steel by welding or bolting to steel supporting members.
    b. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

3.3 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: As directed Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Or Section 099600 "High-Performance Coatings," Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055119

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.
2. Aluminum pipe and tube railings.
3. Stainless-steel pipe and tube railings.

B. Related Requirements:

1. Section 055112 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.
3. Section 096900 "Access Flooring" for railings included with access flooring.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

E. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:

B. Aluminum Pipe and Tube Railings:

C. Stainless-Steel Pipe and Tube Railings:

D. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 20 deg F (67 deg C), ambient; 180 deg F (100 deg C),material surfaces.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A500 (cold formed) or ASTM A513.

B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

E. Expanded Metal: ASTM F1267, Type I (expanded), Type II (expanded and flattened), Class 1 (uncoated).

1. Style Designation: 3/4 number 13 or 1-1/2 number 10 as directed.

F. Perforated Metal: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.

G. Perforated Metal: Galvanized-steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch (1.63 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows, with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.

H. Woven-Wire Mesh: Intermediate-crimp, diamond, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.134-inch- (3.42-mm-) diameter wire complying with ASTM A510 (ASTM A510M).

2.5 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B210 (ASTM B210M), Alloy 6063-T832.

E. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

H. Perforated Metal: Aluminum sheet, ASTM B209 (ASTM B209M), Alloy 6061-T6, 0.063 inch (1.60 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.

I. Woven-Wire Mesh: Intermediate-crimp, diamond, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch- (4.1-mm-) diameter wire complying with ASTM B211 (ASTM B211M), Alloy 6061-T94.

2.6 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304, Grade MT 316L.

B. Pipe: ASTM A312/A312M, Grade TP 304, Grade TP 316L.

C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20, Grade CF 8M or CF 3M.

D. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316L.

E. Expanded Metal: ASTM F1267, Type I (expanded), Type II (expanded and flattened), Class 3 (corrosion-resistant steel), made from stainless-steel sheet, ASTM A240/A240M or ASTM A666, Type 304, Type 316.

1. Style Designation: 3/4 number 13, 1-1/2 number 10.

F. Perforated Metal: Stainless-steel sheet, ASTM A240/A240M or ASTM A666, Type 304 Type 316L, 0.062 inch (1.59 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching product indicated on Drawings.

G. Woven-Wire Mesh: Intermediate-crimp, diamond, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.141-inch- (3.57-mm-) diameter wire complying with ASTM A580/A580M, Type 304, Type 316.

2.7 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329 for zinc coating.
3. Aluminum Railings: Type 304, Type 316 stainless-steel fasteners.
4. Stainless-Steel Railings: Type 304, Type 316 stainless-steel fasteners.
5. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide Phillips, tamper-resistant, square or hex socket, flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors, capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.8 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

H. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

I. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

J. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

L. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

M. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.9 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded, nonwelded, either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form Changes in Direction as Follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide steel, stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

R. For removable railing posts, fabricate slip-fit sockets from steel, stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch (1.1 mm) thick.
2. Orient expanded metal with long dimension of diamonds parallel to top rail, perpendicular to top rail, horizontal, vertical, as indicated on Drawings.

T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from steel, galvanized steel, aluminum, stainless steel, same metal as railings in which they are installed.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
2. Orient perforated metal with pattern parallel to top rail, perpendicular to top rail, horizontal, vertical, as indicated on Drawings.

U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with diamonds vertical, diamonds perpendicular to top rail, wires perpendicular and parallel to top rail, wires horizontal and vertical, as indicated on Drawings.

V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.10 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior, indicated steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning." Requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer, primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting", unless ,zinc-rich primer is, primers specified in Section 099600 "High-Performance Coatings" are indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting." Section 099600 "High-Performance Coatings."

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

2.11 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A41, AA-M12C22A31.

D. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, AA-M12C22A32/A34.

1. Color: Light bronze, Medium bronze, Dark bronze, Black.
2. Color: Match Architect's sample, As selected by Architect from full range of industry colors and color densities.

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604, AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range.

G. High-Performance Organic Finish: Three, Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range.

2.12 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish, to a mirror-like finish, to match Architect?s sample.

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A489/A480, No. 4.
2. High Luster Finish: ASTM A480/A480M, No. 7.
3. Mirror Finish: ASTM A480/A480M, No. 8.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material, attached to post with set screws.

D. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post, anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.

3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends, or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal bar gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 055100 "Metal Stairs" for grating treads and landings of steel-framed stairs.
3. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.
2. Paint products.

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For gratings, including manufacturers' published load tables, analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. (6.00 kN/sq. m) or concentrated load of 2000 lbf (8.90 kN), whichever produces the greater stress.
2. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 3000 lbf (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft. (2.87 kN/sq. m).
4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.

6. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.3 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual", and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welded Steel Grating MBG-<#:

1. Bearing Bar Spacing: 7/16 or 1/2 inch (11 or 13 mm), 11/16 inch (17 mm), 15/16 inch (24 mm), 1-3/16 inches (30 mm), 1-3/8 inches (35 mm), 1-7/8 inches (48 mm), 2-3/8 inches (60 mm) o.c.
2. Bearing Bar Depth: 3/4 inch (19 mm), 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 3-1/2 inches (89 mm), 4 inches (102 mm), 4-1/2 inches (114 mm), 5 inches (127 mm), As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), 1/4 inch (6.4 mm), 3/8 inch (9.5 mm), As required to comply with structural performance requirements.
4. Crossbar Spacing: 2 inches (51 mm), 4 inches (102 mm) o.c.
5. Grating Mark W-11-4 (1 x 3/16) STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Grating Mark W-15-4 (1 x 1/8) STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
7. Grating Mark W-19-4 (1-1/4 x 3/16) STEEL: 1-1/4-by-3/16-inch (32-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
8. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
9. Grating Mark W-19-4 (2 x 1/4) STEEL: 2-by-1/4-inch (51-by-6.4-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
10. Grating Mark W-30-4 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars at 1-7/8 inches (60 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
11. Grating Mark: As indicated.
12. Traffic Surface: Plain, Serrated, Knurled, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive as indicated.
13. Steel Finish: Shop primed, Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

C. Pressure-Locked Steel Grating MBG-<#>: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 7/16 or 1/2 inch (11 or 13 mm), 11/16 inch (17 mm), 15/16 inch (24 mm), 1-3/16 inches (30 mm) o.c.

2. Bearing Bar Depth: 3/4 inch (19 mm), 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), As required to comply with structural performance requirements.
4. Crossbar Spacing: 2 inches (51 mm), 4 inches (102 mm) o.c.
5. Grating Mark P-11-4 (1 x 3/16) STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Grating Mark P-15-4 (1-1/4 x 1/8) STEEL: 1-1/4-by-1/8-inch (32-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
7. Grating Mark P-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
8. Grating Mark: As indicated.
9. Traffic Surface: Plain, Serrated, Knurled, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, As indicated.
10. Steel Finish: Shop primed, Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

D. Riveted Steel Grating MBG-<#>:

1. Bearing Bar Spacing: 3/4 inch (19 mm), 1-1/8 inches (29 mm), 2-5/16 inches (59 mm) clear.
2. Bearing Bar Depth: 3/4 inch (19 mm), 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 3-1/2 inches (89 mm), 4 inches (102 mm), 4-1/2 inches (114 mm), 5 inches (127 mm), As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), 1/4 inch (6.4 mm), 3/8 inch (9.5 mm), As required to comply with structural performance requirements.
4. Rivet Spacing: 3-1/2 inches (89 mm), 5 inches (127 mm), 7 inches (178 mm) o.c. along bearing bar.
5. Grating Mark R-12-3-1/2 (1 x 1/8) STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars with 3/4-inch (19-mm) clear space between bearing bars, and rivets at 3-1/2 inches (89 mm) o.c. along bearing bar.
6. Grating Mark R-18-7 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars with 1-1/8-inch (29-mm) clear space between bearing bars, and rivets at 7 inches (178 mm) o.c. along bearing bar.
7. Grating Mark R-37-5 (4 x 1/4) STEEL: 4-by-1/4-inch (102-by-6.4-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
8. Grating Mark R-37-5 (5 x 3/8) STEEL: 5-by-3/8-inch (127-by-9.5-mm) bearing bars with 2-5/16-inch (59-mm) clear space between bearing bars, and rivets at 5 inches (127 mm) o.c. along bearing bar.
9. Grating Mark: As indicated.
10. Traffic Surface: Plain, Serrated, Knurled, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, As indicated.
11. Steel Finish: Shop primed, Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

E. Pressure-Locked, Stainless-Steel Grating MBG-<#>: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 7/16 or 1/2 inch (11 or 13 mm), 11/16 inch (17 mm), 15/16 inch (24 mm), 1-3/16 inches (30 mm), 1-3/8 inches (35 mm), 1-7/8 inches (48 mm), 2-3/8 inches (60 mm) o.c.
2. Bearing Bar Depth: 3/4 inch (19 mm), 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 3-1/2 inches (89 mm), 4 inches (102 mm), 4-1/2 inches (114 mm), 5 inches (127 mm), As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), 1/4 inch (6.4 mm), 3/8 inch (9.5 mm), As required to comply with structural performance requirements.
4. Crossbar Spacing: 2 inches (51 mm), 4 inches (102 mm) o.c.
5. Grating Mark P-11-4 (1 x 3/16) STAINLESS STEEL: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Grating Mark P-15-2 (1 x 1/8) STAINLESS STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 2 inches (51 mm) o.c.
7. Grating Mark P-19-4 (1-1/2 x 3/16) STAINLESS STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
8. Grating Mark P-30-4 (3 x 3/8) STAINLESS STEEL: 3-by-3/8-inch (76-by-9.5-mm) bearing bars at 1-7/8 inches (48 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
9. Grating Mark: As indicated.
10. Traffic Surface: Plain, Serrated, Knurled, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, As indicated.
11. Finish: Mill finish, Abrasive blasted, Electropolished.

F. Pressure-Locked, Rectangular-Bar Aluminum Grating MBG-<#>: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 7/16 or 1/2 inch (11 or 13 mm), 11/16 inch (17.5 mm), 15/16 inch (24 mm), 1-3/16 inches (30 mm) o.c.
2. Bearing Bar Depth: 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), As required to comply with structural performance requirements.
3. Bearing Bar Thickness: 1/8 inch (3.2 mm), 3/16 inch (4.8 mm), 1/4 inch (6.4 mm), As required to comply with structural performance requirements.
4. Crossbar Spacing: 2 inches (51 mm) or 4 inches (102 mm) o.c. as directed
5. Grating Mark P-7-4 (1 x 1/8) ALUMINUM: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 7/16 inch (11 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Grating Mark P-11-4 (1 x 3/16) ALUMINUM: 1-by-3/16-inch (25-by-4.8-mm) bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
7. Grating Mark P-15-4 (1-1/2 x 3/16) ALUMINUM: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
8. Grating Mark P-19-4 (2 x 3/16) ALUMINUM: 2-by-3/16-inch (51-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
9. Grating Mark: As indicated.
10. Traffic Surface: Plain, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, As indicated.

11. Aluminum Finish: Mill finish, Class I, clear, anodized finish.

G. Pressure-Locked, Aluminum I-Bar Grating MBG-<#>: Fabricated by swaging crossbars between bearing bars.

1. Bearing Bar Spacing: 7/16 or 1/2 inch (11 or 13 mm), 11/16 inch (17 mm), 15/16 inch (24 mm), 1-3/16 inches (30 mm) o.c.
2. Bearing Bar Depth: 1 inch (25 mm), 1-1/4 inches (32 mm), 1-1/2 inches (38 mm), 1-3/4 inches (44 mm), 2 inches (51 mm), 2-1/4 inches (57 mm), 2-1/2 inches (64 mm), As required to comply with structural performance requirements.
3. Bearing Bar Flange Width: 1/4 inch (6.4 mm).
4. Crossbar Spacing: 2 inches (51 mm), 4 inches (102 mm) o.c.
5. Grating Mark P-11-4 (1 I-Bar) ALUMINUM: 1-inch (25-mm) I-bar bearing bars at 11/16 inch (18 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Grating Mark P-15-2 (1 I-Bar) ALUMINUM: 1-inch (25-mm) I-bar bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 2 inches (51 mm) o.c.
7. Grating Mark P-19-4 (1-1/2 I-Bar) ALUMINUM: 1-1/2-inch (38-mm) I-bar bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
8. Grating Mark: As indicated.
9. Traffic Surface: Plain, Grooved, Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive, As indicated.
10. Aluminum Finish: Mill finish, Class I, clear, anodized finish.

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510 (ASTM A510M).

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 304, Type 316L.

G. Stainless-Steel Bars and Shapes: ASTM A276, Type 304, Type 316L.

2.5 ALUMINUM

A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

2. 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 5052-H32.

2.6 FASTENERS

A. General: Unless otherwise indicated, provide Type 304, Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M,) and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1), Group 2 (A4).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M,) and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.7 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting" and Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.8 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced 15/16 inch (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
3. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced less than 15/16 inch (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
5. Furnish threaded bolts with nuts and washers for securing grating to supports.
6. Furnish self-drilling fasteners with washers for securing grating to supports.
7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.9 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.
2. Interior, where indicated.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.

2.11 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Shop prime gratings, frames, and supports not indicated to be galvanized unless otherwise indicated.

1. Shop prime with universal shop primer, primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless zinc-rich primer is, primers specified in Section 099600 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning." requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055313

SECTION 055316 - PLANK GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes formed-metal plank gratings, extruded-aluminum plank gratings, and metal frames and supports for gratings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Paint products.

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For gratings, including manufacturers' published load tables, analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. (6.00 kN/sq. m) or concentrated load of 2000 lbf (8.90 kN), whichever produces the greater stress.
2. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 3000 lbf (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft. (2.87 kN/sq. m).
4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.
6. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.2 FORMED-METAL PLANK GRATINGS

A. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.
1. Channel Width: 4-3/4 inches (121 mm), 7 inches (178 mm), 9-1/2 inches (241 mm), 11-3/4 inches (298 mm), 18-3/4 inches (476 mm), 24 inches (610 mm), As indicated, As required to comply with structural performance requirements.
2. Channel Depth: 1-1/2 inches (38 mm), 2 inches (51 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), As indicated. As required to comply with structural performance requirements.
3. Material: 0.074-inch- (1.9-mm-) thick steel sheet, shop primed, 0.104-inch- (2.65-mm-) thick steel sheet, shop primed, 0.079-inch- (2.0-mm-) thick, hot-dip galvanized-steel sheet, 0.108-inch- (2.8-mm-) thick, hot-dip galvanized-steel sheet, 0.074-inch- (1.9-mm-) thick steel sheet, hot-dip galvanized after fabrication, 0.104-inch- (2.65-mm-) thick steel sheet, hot-dip galvanized after fabrication, 0.062-inch- (1.6-mm-) thick, stainless-steel sheet, 0.078-inch- (2.0-mm-) thick, stainless-steel sheet, 0.080-inch- (2.0-mm-) thick aluminum sheet, 0.100-inch- (2.5-mm-) thick aluminum sheet.

2.3 EXTRUDED-ALUMINUM PLANK GRATINGS

A. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

1. Type: Extruded-aluminum planks approximately 6 inches (152 mm) wide with multiple flanges approximately 1.2 inches (30 mm) o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised ribs to increase slip resistance.
2. Depth: 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (51 mm), As required to comply with structural performance requirements.
3. Perforations: None Rectangular, 19/32 by 3 inches (15 by 76 mm), with adjacent rows staggered, 19/32 inch (15 mm) square, with adjacent rows aligned.
4. Finish: Mill finish, as fabricated.

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

C. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 304, Type 316L.

E. Stainless-Steel Bars and Shapes: ASTM A276, Type 304, Type 316L.

2.5 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
2. 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 5052-H32.

2.6 FASTENERS

A. General: Unless otherwise indicated, provide Type 304, Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1), Group 2 (A4).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.7 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting" and Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.8 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Fit exposed connections accurately together to form hairline joints.

C. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

D. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates for attaching in the field.
2. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

E. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.

1. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

F. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3.2 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.9 GRATING FRAMES AND SUPPORTS

A. Frames and Supports: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6.4 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.
2. Interior, where indicated.

2.10 ALUMINUM FINISHES

A. Class I, Clear Anodic Finish: AA-M12C22A41 complying with AAMA 611.

2.11 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Shop prime gratings, frames and supports not indicated to be galvanized unless otherwise indicated.

1. Shop prime with universal shop primer, primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless, zinc-rich primer is primers specified in Section 099600 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning." requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

B. Attach removable units to supporting members by bolting at every point of contact.

C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055316

SECTION 055319 - EXPANDED METAL GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes expanded metal gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For paint products.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. (6.00 kN/sq. m) or concentrated load of 2000 lbf (8.90 kN), whichever produces the greater stress.
2. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 3000 lbf (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft. (2.87 kN/sq. m).
4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.
6. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.3 EXPANDED METAL GRATINGS

A. Provide expanded metal gratings in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

1. Material: Steel, Stainless steel, Aluminum.
2. Steel Finish: Unfinished, oiled, Shop primed, Galvanized.
3. Stainless-Steel Finish: Mill finish, as fabricated.
4. Aluminum Finish: Mill finish, as fabricated.
5. Style Designation: 4.27 lb, 3/4 number 9.
6. Style Designation: 1-1/2 number 9, 3/4 number 9.
7. Size: 2 lb., 3/4 0.188, 1-1/2 0.125.
8. Type: I, expanded, II, expanded and flattened.

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

C. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

D. Expanded Metal Carbon Steel: ASTM F1267, Class 1.

E. Expanded Metal Galvanized Steel: ASTM F1267, Class 2, Grade A.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 304, Type 316L.

G. Stainless-Steel Bars and Shapes: ASTM A276, Type 304, Type 316L.

H. Expanded Metal Stainless Steel: ASTM F1267, Class 3, made from stainless-steel sheet, ASTM A240/A240M, Type 304, Type 316L.

2.5 ALUMINUM

A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
2. 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 5052-H32.

2.6 FASTENERS

A. General: Unless otherwise indicated, provide Type 304, Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy , Group 1 (A1), Group 2 (A4).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.7 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting" and Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.8 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Fit exposed connections accurately together to form hairline joints.

D. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates for attaching in the field.
2. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

F. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with bars having a thickness not less than overall grating thickness at contact points.

G. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3 mm) thick to the cut ends. Divide panels into sections only to the extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.9 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.
2. Interior, where indicated.

2.10 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Shop prime gratings, frames, and supports not indicated to be galvanized unless otherwise indicated.

1. Shop prime with universal shop primer, primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless zinc-rich primer is primers specified in Section 099600 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning." requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLING EXPANDED METAL GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings.

B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.

C. Attach removable units to supporting members by bolting at 6-inch (150-mm) intervals.

D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at 6-inch (150-mm) intervals.

E. Attach aluminum units to steel supporting members by bolting at 6-inch (150-mm) intervals.

F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055319

SECTION 055813 - COLUMN COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes spackled-seam and snap-together metal column covers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator, organic-coating applicator, anodic finisher and powder-coating applicator.

B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrorlike stainless-steel finish and statuary conversion coating copper-alloy finish to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups of typical column covers.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 SPACKLED-SEAM COLUMN COVERS

A. Form column covers from 0.125-inch (3.2-mm) aluminum sheet complying with ASTM B209 (ASTM B209M), with not less than strength and durability properties of Alloy 5005-H32; rolled to radii indicated. Taper edges of adjoining pieces of column covers, for taping and spackling, to 0.094-inch (2.4-mm) thickness in approximately 1 inch (25 mm) of width. Punch tapered edges for gypsum board screws at 1/2 inch (12 mm) o.c., and mill grooves in tapered edge to improve bond with joint compound.

1. Support Framing: At vertical joints, provide 1-1/2-by-3-5/8-inch (38-by-89-mm) steel channel support posts formed from 0.040-inch (1.0-mm) galvanized steel.
2. Joint Treatment Materials: Provide joint treatment compounds and reinforcing tape complying with requirements in Section 092900 "Gypsum Board."

2.2 SNAP-TOGETHER COLUMN COVERS

A. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Aluminum Sheet: ASTM B209 (ASTM B209M), with not less than strength and durability properties of Alloy 5005-H32, 0.063 inch (1.60 mm) thick.

    a. Finish: Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic, Color anodic.

2. Steel Sheet: Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, exposed, 0.060 inch (1.52 mm) thick.

    a. Finish: Factory primed, Baked enamel, Powder coat.

3. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316, 0.050 inch (1.27 mm) thick.

    a. Finish: No. 2B, No. 4, No. 6, No. 7, No. 8.

4. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper) or Alloy UNS C23000 (red brass, 85 percent copper), 0.051 inch (1.29 mm) thick.

    a. Finish: Buffed finish, lacquered, Hand-rubbed finish, lacquered, Statuary conversion coating over satin finish.

5. Brass Sheet: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper), 0.051 inch (1.29 mm) thick.

    a. Finish: Buffed, Hand-rubbed finish, lacquered.

6. Column covers may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.
7. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
8. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
9. Form returns at vertical joints to provide hairline V-joints.
10. Form returns at vertical joints to provide 1/2-inch- (12-mm-), 3/4-inch- (18-mm-) wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals 1/2 inch (12 mm) deep, flush.
11. Form returns at vertical joints to accommodate backer rod and sealant.
12. Fabricate column covers with hairline horizontal V-joints produced by forming returns on mating ends of column cover sections. Locate horizontal joints as indicated.
13. Fabricate column covers without horizontal joints.
14. Fabricate column covers with horizontal butt joints, tightly fitted and backed with a sleeve for field splicing with adhesive.
15. Fabricate column covers with 1/2-inch- (12-mm-) wide reveals at horizontal joints produced by forming returns on mating ends of column cover sections. Provide snap-in metal filler strips at reveals matching reveals at vertical joints. Locate horizontal joints as indicated.
16. Fabricate base, ceiling, ring to match, contrast with column covers.
17. Fabricate with calk stop/stiffener ring.
18. Apply manufacturer's recommended sound-deadening insulation, mastic to backs of column covers.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless, otherwise indicated, exposed fasteners are unavoidable or are the standard fastening method.
2. Provide Phillips, tamper-resistant, square or hex socket, flat-head machine screws for exposed fasteners unless otherwise indicated.

B. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C665, Type I, and passing ASTM E136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.4 PAINTS AND COATINGS

A. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.

B. Shop Primers: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION, GENERAL

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

2.6 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Champagne, Light bronze, Medium bronze, Dark bronze, Black.
2. Color: Match Architect's sample, As selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range.

D. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604, AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As directed.

F. High-Performance Organic Finish: Three, Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

2.8 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Baked-Enamel Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

E. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

D. Directional Satin Finish: No. 4.

E. Dull Satin Finish: No. 6.

F. Satin, Reflective, Directional Polish: No. 7.

G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

2.10 COPPER-ALLOY FINISHES

A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

C. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

E. Apply joint treatment at joints of spackled-seam metal column covers. Comply with requirements in Section 092900 "Gypsum Board."

3.3 ADJUSTING AND CLEANING

A. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

B. Touchup Painting: Immediately after erection, clean abraded areas of shop paint and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting" Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 055813

SECTION 055819 - HEATING/COOLING UNIT COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes heating-cooling unit enclosures.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for heating-cooling unit enclosures.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For heating-cooling unit enclosures. Show dimensions of heating-cooling units, including locations of housing penetrations and attachments, and necessary clearances.

B. Qualification Data: For fabricator, organic-coating applicator and powder-coating applicator.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing heating-cooling unit enclosures similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups of typical heating-cooling unit enclosures as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver heating-cooling unit enclosures wrapped in protective coverings or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with heating-cooling unit enclosures by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design heating-cooling unit enclosures.

B. Structural Performance: Heating-cooling unit enclosures shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:

1. Live Loads: 100 lbf/sq. ft. (4.8 kN/sq. m) or a concentrated load of 300 lbf (1.3 kN) on an area of 4 sq. in. (26 sq. cm), whichever produces the greater stress.

2.2 HEATING-COOLING UNIT ENCLOSURES

A. Fabricate heating-cooling unit enclosures from metal of type and thickness indicated below:

1. Galvanized-Steel Sheet:

   a. Framing: 0.108 inch (2.74 mm) Thickness required to comply with performance requirements.
   b. Sills and Stools: 0.079 inch (2.01 mm) Thickness required to comply with performance requirements.
   c. Front Panels and Bases: 0.064 inch (1.63 mm).
   d. Concealed Panels and Trim: 0.040 inch (1.02 mm).
   e. Finish: Factory primed, Baked enamel, Siliconized polyester, High-performance organic coating, Powder coat.

2. Steel Sheet:

   a. Framing: 0.105 inch (2.66 mm) Thickness required to comply with performance requirements.
   b. Sills and Stools: 0.075 inch (1.90 mm) Thickness required to comply with performance requirements.
   c. Front Panels and Bases: 0.060 inch (1.52 mm).
   d. Concealed Panels and Trim: 0.036 inch (0.91 mm).
   e. Finish: Factory primed, Baked enamel, Powder coat.

B. Weld seams and connections unless otherwise indicated or unless other methods are necessary for access to heating and cooling equipment.

C. Incorporate stiffeners or laminated backing using noncombustible materials as needed for strength and rigidity.

1. Fill space between stiffeners with sound-deadening insulation attached to face sheet with insulation adhesive unless otherwise indicated.
2. Coat concealed faces of metal panels more than 6 inches (150 mm) wide with a heavy coating of sound-deadening mastic applied at the minimum rate of 20 sq. ft./gal. (0.5 sq. m/L).

D. Provide louvers and grilles of size, type, and materials indicated.

1. For removable grilles, use modular units with recessed openings formed into surfaces of enclosures and without blank filler panels between grilles, so face panels and stools are continuous. Fabricate removable grilles and openings to precise tolerances to produce well-fitted assemblies free of warp or rattle, with grilles supported continuously along parallel edges and with tops flush with top of enclosure.

E. Incorporate removable tops and fronts where indicated or needed for access to heating-cooling units and to piping, ductwork, controls, and electrical service, with panels and openings as follows:

1. Fabricate with a fitting tolerance of not less than 1/32 inch (0.8 mm) and not more than 1/16 inch (1.6 mm) at each edge, with face of panels flush with adjoining fixed surfaces of enclosure.
2. Form panels for easy removal without interfering with adjoining construction or furniture. Hold panels in place with concealed clips and hardware that prevent warp and rattle.

F. Incorporate hinged access panels in enclosures for access to heating-cooling unit controls, as either separate elements or integrated with grille openings, as indicated or needed.

G. Coordinate construction, configuration, and dimensions of enclosures with those of heating-cooling units. Provide support for heating-cooling units and controls where indicated. Provide blind knockouts and supports for piping, ductwork, control lines, electrical conduit, and wiring where indicated or needed.

H. Locate fixed surfaces of enclosure to coincide precisely with window mullions and partition system terminations. Provide closures at ends of units, at recessed openings in base of units, and at other locations where needed to conceal unfinished wall or floor surfaces, piping, conduit, ductwork, or heating-cooling units.

1. Provide built-in partitions (bulkheads) within enclosures between heating-cooling units, located to coincide with mullions and partition system terminations. Seal partitions to faces of enclosures with compressible gaskets or mastic sealing tape and cover both sides of partitions with sound-deadening insulation attached to partitions with insulation adhesive.

2.3 SHEET METAL

A. Fabricate units from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel or forming steel.

C. Steel Sheet: Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, exposed or electrolytic zinc-coated, ASTM A879/A879M, with steel sheet substrate complying with ASTM A1008/A1008M, commercial steel, exposed.

2.4 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in heating-cooling unit enclosures; as recommended in writing by heating-cooling unit enclosure manufacturer.

1. ASTM D1056, Type 1, Class A, and grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed-cell polyurethane foam, adhesive on two sides, and release paper protected.

B. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

C. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless otherwise indicated, exposed fasteners are unavoidable or are the standard fastening method.
2. Provide Phillips, tamper-resistant, square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Sound-Deadening Materials:

1. Insulation: Unfaced mineral-fiber blanket insulation complying with ASTM C665, Type I, and passing ASTM E136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Isolation Coating: Manufacturer's standard alkali-resistant coating, bituminous paint, epoxy coating.

2.5 PAINTS AND COATINGS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Shop Primers: Comply with Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

D. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Water-based galvanized metal primer complying with MPI#134.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble heating-cooling unit enclosures in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of heating-cooling unit enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor heating-cooling unit enclosures to adjoining construction.

F. Provide support framing, mounting, and attachment clips; splice sleeves; fasteners; and accessories needed to install heating-cooling unit enclosures.

G. Where welding is indicated, weld joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

2.7 GALVANIZED-STEEL SHEET FINISHES

A. Preparing Galvanized Items for Factory Priming: Thoroughly clean galvanized decorative formed metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

B. Preparing Galvanized Items for Factory Finishing: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Repairing Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

D. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

E. Baked-Enamel Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

F. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

G. Siliconized-Polyester Coating: After cleaning and pretreating, apply manufacturer's standard epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range and or as directed.

H. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604, AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range and or as directed.

I. High-Performance Organic Finish: Three, Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range and or as directed.

2.8 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Baked-Enamel Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range and or as directed.

E. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range and or as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of heating-cooling unit enclosures.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place heating-cooling unit enclosures level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install heating-cooling unit enclosures.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of heating-cooling unit enclosures from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 055819

SECTION 055963 - DETENTION ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bar-grille assemblies.
2. Woven-rod-mesh assemblies.
3. Security grilles.
4. Perforated-plate security vents.
5. Perforated-plate security vents with wire mesh.
6. Perforated-plate security vents with backup plate.
7. Tool-resisting-steel, perforated-plate security vents.

B. Related Requirements:

1. Section 013513.16 "Special Project Procedures for Detention Facilities" for general requirements for detention work.
2. Section 099113 "Exterior Painting" for field painting of detention enclosures.
3. Section 099123 "Interior Painting" for field painting of detention enclosures.

1.3 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by a Detention Specialist or other entity.

B. Coordinate installation of anchorages for detention enclosures. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

C. Coordinate size of security grilles and vents with size of ducts.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention enclosures.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For detention enclosures.

1. Include plans, elevations, sections, and attachment details.
2. Indicate location, plan, and dimension of each detention enclosure.
3. Indicate type of steel for each detention enclosure component.
4. Indicate requirements for cast-in anchors to be installed as work of other Sections.
5. Show elevations of each detention enclosure door and indicate location, dimensions, door swing/slide direction, details of detention door hardware and accessories, and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of detention enclosure indicated.

1. Include 12-by-12-inch (305-by-305-mm) cut-away corner section of bar-grille assembly, constructed of specified round and flat bars, showing fabrication techniques and workmanship.
2. Include 12-by-12-inch (305-by-305-mm) cut-away corner section of woven-rod-mesh assembly, constructed of specified framing and woven-rod panel, showing fabrication techniques and workmanship.
3. Include one full-size security grille and vent unit.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, manufacturer and testing agency.

B. Welding certificates.

C. Material Certificates: For tool-resisting steel indicating compliance with the performance requirements for complete test sequence according to applicable ASTM standard.

D. Material Test Reports: For tool-resisting steel, by a qualified testing agency.

E. Mill Certificates: For tool-resisting-steel rods used in woven-rod mesh assemblies, certifying that rods were fabricated from material with same chemical and physical properties as material used to fabricate tool-resisting-steel round bars.

F. Examination reports documenting inspections of substrates, areas, and conditions.

G. Anchor-inspection reports documenting inspections of built-in and cast-in anchors.

H. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor and Detention Specialist.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For doors in detention enclosures to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Security Fasteners: Furnish not less than one box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.
2. Tools: Provide two sets of tools for installing and removing security fasteners.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with detention enclosures by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 BAR-GRILLE ASSEMBLIES

A. Tool-Resisting-Steel Bar Grilles: ASTM A627, Grade 1, Grade 2.

1. Vertical Bars: 1-inch- (25.4-mm-) diameter, double-ribbed, round, hexagonal composite tool-resisting-steel bars at 4 inches (102 mm), 5 inches (127 mm), 6 inches (152 mm) o.c.
2. Horizontal Flat Bars: 3/8-by-2-1/2-inch (9.6-by-63.5-mm) composite tool-resisting-steel flat bars at 12 inches (305 mm) or 18 inches (457 mm) o.c. as directed.

3. Perimeter Framing: 3/8-by-2-1/2-inch (9.6-by-63.5-mm) composite tool-resisting-steel flat bars.

B. Tool-Resisting-Steel Bar Grilles: ASTM A627, Grade 3.

1. Vertical Bars: 1-inch- (25.4-mm-) diameter, double-ribbed, round, hexagonal homogeneous tool-resisting-steel bars at 4 inches (102 mm), 5 inches (127 mm), 6 inches (152 mm) o.c.
2. Horizontal Flat Bars: 5/16-by-2-1/4-inch (7.9-by-57.2-mm) homogeneous tool-resisting-steel flat bars at 12 inches (305 mm) or 18 inches (457 mm) o.c.
3. Perimeter Framing: 5/16-by-2-1/4-inch (7.9-by-57.2-mm) homogeneous tool-resisting-steel flat bars.

C. Tool-Resisting-Steel Bar Grilles: ASTM A627, Grade 4.

1. Vertical Bars: 7/8-inch- (22.2-mm-) diameter, double-ribbed, round, hexagonal homogeneous tool-resisting-steel bars at 4 inches (102 mm), 5 inches (127 mm), 6 inches (152 mm) o.c.
2. Horizontal Flat Bars: 1/4-by-2-inch (6.4-by-50.8-mm) homogeneous tool-resisting-steel flat bars at 12 inches (305 mm), 18 inches (457 mm) o.c.
3. Perimeter Framing: 1/4-by-2-inch (6.4-by-50.8-mm) homogeneous tool-resisting-steel flat bars.

D. Mild-Steel Bar Grilles:

1. Vertical Bars: 7/8-inch- (22.2-mm-) diameter, double-ribbed, round, hexagonal, mild-steel bars at 4 inches (102 mm), 5 inches (127 mm), 6 inches (152 mm) o.c.
2. Horizontal Flat Bars: 3/8-by-2-1/4-inch (9.5-by-57-mm) mild-steel flat bars at 12 inches (305 mm), 18 inches (457 mm) o.c.
3. Perimeter Framing: 3/8-by-2-1/4-inch (9.5-by-57-mm) mild-steel flat bars.

E. Materials:

1. Tool-Resisting-Steel Round and Flat Bars: ASTM A627.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

F. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

2.3 WOVEN-ROD-MESH ASSEMBLIES

A. Main Framing: Formed from 1-1/2-by-2-1/2-inch (38-by-63.5-mm) built-up tubular steel consisting of an open channel with fixed concealment plates.

1. Open Channel: Formed from 0.134-inch (3.42-mm), 0.105-inch (2.66-mm) nominal-thickness steel sheet or channel with individual slots along inner edges to support woven-rod panels.
2. Concealment Plates: Steel sheet, nominal thickness to match open channel.

B. Supplementary Framing: Formed from 2-inch-square by 3/16-inch- (51-mm-square by 4.8-mm) thick steel tubing.

C. Braces: Formed from same material as main framing.

D. Woven-Rod Panels: Formed from double crimped, 1/4-inch- (6-mm-), 3/8-inch- (9.5-mm-) diameter steel rod, woven horizontally and vertically into a rigid grille with rods at 2 inches (51 mm) o.c.

1. Steel Rod: Mild, Homogeneous tool-resisting steel.

E. Floor Anchor Clips: 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) mild-steel angles for straight framing; 1-1/2-by-1-1/2-by-3/16-inch (38-by-38-by-4.8-mm) mild-steel angles for corners.

F. Floor Anchors: 2-inch-square by 3/16-inch- (51-mm-square by 4.8-mm-) thick, mild-steel tubing sleeve welded to 6-inch-square by 3/16-inch- (152-mm-square by 4.8-mm-) thick, mild-steel plate.

G. Wall and Ceiling Anchors and Trim: Continuous 2-by-2-by-3/16-inch (51-by-51-by-4.8-mm) mild-steel angle with 2-by-3/16-inch (51-by-4.8-mm) mild-steel flat bar.

H. Materials:

1. Tool-Resisting-Steel Round Rods: Rods fabricated from material with same chemical and physical properties as tool-resisting-steel round bars.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.
3. Steel Sheet: Cold-rolled ASTM A1008/A1008M or hot-rolled ASTM A1011/A1011M, CS (Commercial Steel), Type B; suitable for exposed applications.
4. Steel Tubing: ASTM A501/A501M or ASTM A513/A513M, Type B unless otherwise indicated.

I. Finishes:

1. Interior Locations:

a. Steel and Galvanized-Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
b. Steel and Galvanized-Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1) Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from manufacturer's full range and or as directed.

2. Exterior Locations:

a. Galvanized-Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

b. Galvanized-Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1) Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

2.4 SECURITY GRILLES

A. Wire Mesh: 0.135-inch- (3.5-mm-) diameter steel wire woven into a 3/8-inch (9.5-mm) mesh attached to perimeter sleeve by bolts or studs, welding.

B. Perimeter Sleeve: 3/16-inch- (4.8-mm-) thick, mild-steel flat bar frame with anchor studs, masonry anchors, angle mounting frames.

C. Vertical Bars: 7/8-inch- (22-mm-), 1-inch- (25-mm-) diameter, double-ribbed, round, hexagonal, mild-steel, homogeneous tool-resisting-steel, bars at 4 inches (102 mm) o.c.

D. Flat Bar Interior Frame: 2-1/2-by-3/8-inch- (63.5-by-9.5-mm-) thick, mild-steel, homogeneous tool-resisting-steel, flat bars.

E. Horizontal Flat Bars: 2-1/2-by-3/8-inch- (63.5-by-9.5-mm-) thick, mild-steel, homogeneous tool-resisting-steel, flat bars 12 inches (305 mm) o.c.

F. Materials:

1. Tool-Resisting-Steel Round and Flat Bars: ASTM A627.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

G. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

2.5 PERFORATED-PLATE SECURITY VENTS

A. Faceplate: 3/16-inch- (4.8-mm-) thick, mild-steel, stainless-steel, plate; with 5/16-inch (7.9-mm) round holes staggered 7/16 inch (11 mm) o.c. in each direction.

B. Opening Sleeve: 3/16-inch- (4.8-mm-) thick steel plate welded to faceplate.

C. Perimeter Frame: 1-by-1-by-3/16-inch- (25-by-25-by-4.8-mm-) thick, mild-steel angles.

D. Provide anchor studs welded to back of faceplate for installation into concrete.

E. Provide masonry anchors welded to sleeve for installation into masonry.

F. Damper: Front, Rear-operated, opposed-blade type.

G. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304, Type 316, Type 304 or 316 as indicated.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

H. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

    a. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

3. Stainless-Steel Finishes:

    a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

        1) Run grain of directional finishes with long dimension of each piece.
        2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
        3) Directional Satin Finish: No. 4.

    c. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.6 PERFORATED-PLATE SECURITY VENTS WITH WIRE MESH

A. Faceplate: 0.075-inch (1.90-mm) nominal-thickness, mild-steel, 0.078-inch- (1.98-mm-) thick, stainless-steel sheet; with 3/4-inch- (19-mm-) square perforations 1/4 inch (6 mm) apart in each direction.

B. Wire Mesh: 0.062-inch- (1.6-mm-) diameter steel wire woven into a 1/4-inch (6-mm) mesh, welded to opening sleeve behind faceplate.

C. Opening Sleeve: 0.075-inch (1.90-mm) nominal thickness, formed from steel sheet and welded to faceplate.

D. Perimeter Frame: 1-by-1-by-3/16-inch- (25-by-25-by-4.8-mm-) thick, mild-steel angles.

E. Provide anchor studs welded to back of faceplate for installation into concrete.

F. Provide masonry anchors welded to sleeve for installation into masonry.

G. Damper: Front, Rear-operated, opposed-blade type.

H. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304, Type 316, Type 304 or 316 as indicated.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

I. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

    a. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

3. Stainless-Steel Finishes:

    a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

        1) Run grain of directional finishes with long dimension of each piece.
        2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
        3) Directional Satin Finish: No. 4.

    c. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.7 PERFORATED-PLATE SECURITY VENTS WITH BACKUP PLATE

A. Faceplate: 3/16-inch- (4.8-mm-) thick, mild-steel, stainless-steel, plate; with 2-inch- (51-mm-) square perforations 1 inch (25 mm) apart in each direction.

B. Wire Mesh: 0.135-inch- (3.5-mm-) diameter steel wire woven into a 3/8-inch (9.5-mm) mesh, secured between faceplate and backup plate.

C. Backup Plate: 1/4-inch- (6-mm-) thick, mild-steel plate with perforations matching faceplate.

D. Perimeter Frame: 1-by-1-by-3/16-inch- (25-by-25-by-4.8-mm-) thick, mild-steel angles.

E. Opening Sleeve: 3/16-inch- (4.8-mm-) thick steel plate welded to faceplate.

F. Provide anchor studs welded to back of faceplate for installation into concrete.

G. Provide masonry anchors welded to sleeve for installation into masonry.

H. Damper: Front, Rear-operated, opposed-blade type.

I. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304, Type 316, Type 304 or 316 as indicated.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

J. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

    a. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

3. Stainless-Steel Finishes:

    a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

        1) Run grain of directional finishes with long dimension of each piece.
        2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
        3) Directional Satin Finish: No. 4.

    c. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.8 TOOL-RESISTING-STEEL, PERFORATED-PLATE SECURITY VENTS

A. Faceplate: 1/4-inch- (6-mm-) thick, homogeneous tool-resisting-steel plate; with 2-inch- (51-mm-) square perforations 1 inch (25 mm) apart in each direction.

B. Wire Mesh: 0.135-inch- (3.5-mm-) diameter steel wire woven into a 3/8-inch (9.5-mm) mesh, attached to faceplate by bolts or studs.

C. Backup Plate: 1/4-inch- (6-mm-) thick, homogeneous tool-resisting-steel plate with perforations matching faceplate.

D. Perimeter Frame: 3/16-inch- (4.8-mm-) thick, mild-steel flat bar with anchor studs, masonry anchors, angle mounting frames.

E. Materials:

1. Tool-Resisting-Steel Round and Flat Bars: ASTM A627.
2. Mild-Steel Plates, Shapes, and Bars: ASTM A36/A36M.

F. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

2.9 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.

C. Embedded Plate Anchors: Fabricated from mild-steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch- (12.7-mm-) diameter, headed studs welded to back of plate.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.10 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention enclosures with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form and grind edges and corners to be free of sharp edges or rough areas.

E. Form metal in maximum lengths to minimize joints. Form sheet-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

F. Weld corners and seams continuously to comply with referenced AWS standard and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention enclosures rigidly in place and to support indicated loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap detention enclosures as indicated to receive hardware, security fasteners, and similar items.

I. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

J. Form exposed connections with hairline joints flush and smooth using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security screws. Locate joints where least conspicuous.

K. Exterior Detention Enclosures: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.11 FABRICATION OF BAR-GRILLE ASSEMBLIES

A. Fabricate bar-grille assemblies with materials and to sizes and configurations indicated, complete with mounting flanges and anchors.

1. Pass vertical round bars through, and positively interlock them with, horizontal flat bars at each intersection without reducing circumference of round bars at these intersections

and without using pipe sleeves, swedging, calking, or interlocks that depend on friction. Weld vertical round bars at each intersection with flat bars on both top and underside of flat bar.

2. Pass ends of round bars at least 1 inch (25 mm) through framing, and weld bars to framing from back side of framing.
3. Fabricate cutouts and openings in bar-grille assemblies for penetrations of sizes and at locations indicated. Frame openings with flat bars of same material and size as horizontal flat bars.
4. Frame connections with plates; use flat bars of same material and size as horizontal flat bars.

B. Partitions: Connect top horizontal flat bar to vertical flat bar framing members with 2-by-2-by-1/4-inch- (51-by-51-by-6-mm-) thick, steel plate angle knee welded into place. Connect intersections of horizontal flat bars with vertical flat bar framing members by 3/16-inch (4.8-mm) fillet welds. Weld vertical bars securely to top and bottom flat bar framing members.

C. Doors: Fabricate swinging, sliding doors of same type bar-grille assembly as bar-grille partition in which they are installed. Weld lockbox at lock jamb of door, fabricated of steel plate to match horizontal flat bars. Comply with requirements in Section 087163 "Detention Door Hardware" for detention hinges and detention locks and latches.

1. Food-Pass Openings: Frame top and sides of opening with flat bar of same quality and size as horizontal flat bars. Weld 1/4-inch- (6-mm-) thick steel plate shelf, of same quality as horizontal flat bars, at bottom of opening.

2.12 FABRICATION OF WOVEN-ROD-MESH ASSEMBLIES

A. Main Framing: Before inserting woven-rod panels, weld and grind smooth corners of open channel elements. Fabricate partitions taller than 12 feet (3.6 m) from multiple panels stacked on top of one another.

B. Woven-Rod Panels: Insert panels symmetrically in main framing. Extend end of each rod at least 1 inch (25 mm) into main framing and, from inside of channel, weld into each slot where it contacts main framing.

C. Concealment Plates: Weld plates to main framing with minimum 1 inch (25 mm) welds at minimum 10 inches (254 mm) o.c., staggered side to side and ground smooth, to form a fully enclosed tubular steel frame.

D. Anchor Clips: For each enclosure panel, weld one anchor clip to secure side of main framing in line with vertical framing.

E. Swinging Doors: Fabricate doors with framing on four sides of door from same material as adjacent panels and with 2-by-1/4-inch (51-by-6-mm) flat steel bar astragal continuous on lock jamb. Align bottom of door with bottom of adjacent panels. Comply with requirements in Section 087163 "Detention Door Hardware" for detention hinges and detention locks and latches.

F. Sliding Doors: Fabricate doors with framing on four sides of door from same material as adjacent panels. Align bottom of door with bottom of adjacent panels. Comply with

requirements in Section 087163 "Detention Door Hardware" for sliding detention door device assemblies and detention locks and latches.

G. Hardware Preparation: Mortise, reinforce, drill, and tap doors and main framings for templated hardware to comply with approved Door Hardware Schedule. Frame openings to receive detention door locks.

H. Fabricate joints that will be exposed to weather in a manner to exclude water, and provide weep holes where water may accumulate.

2.13 FABRICATION OF SECURITY GRILLES AND VENTS

A. Fabricate security grilles and vents with materials and to sizes and configurations indicated, complete with mounting flanges and anchors.

B. Security Grilles:

1. Orient axis of ribs of each double-ribbed round bar to run parallel to airflow.
2. Pass vertical round bars through, and positively interlock them with, horizontal flat bars at each intersection without reducing circumference of round bars at these intersections and without using pipe sleeves, swedging, calking, or interlocks that depend on friction. Weld horizontal flat bars to perimeter sleeve. Weld vertical round bars at each intersection with flat bars on top side of flat bar.
3. Pass ends of round bars through flat bars and weld to flat bars.
4. Weld flat bar interior frame along perimeter sleeve.
5. Weld one angle mounting frame to perimeter sleeve. Leave other angle mounting frame loose for field installation.

C. Where bolts are used to secure wire mesh, once secured, batter threads to prevent nut removal.

2.14 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:
1. Drive-System Type: Pinned Torx-Plus, Pinned Torx.
2. Fastener Strength: 120,000 psi (827 MPa).
3. Socket Button Head Fasteners:

    a. Heat-treated alloy steel, ASTM F835 (ASTM F835M).
    b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

4. Socket Flat Countersunk Head Fasteners:

    a. Heat-treated alloy steel, ASTM F835 (ASTM F835M).
    b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

5. Socket Head Cap Fasteners:

    a. Heat-treated alloy steel, ASTM A574 (ASTM A574M).

b. Stainless steel, ASTM F837 (ASTM F837M), Group 1 CW.

6. Protective Coatings for Heat-Treated Alloy Steel:

a. Zinc and clear trivalent chromium where indicated.
b. Zinc phosphate with oil, ASTM F1137, Grade I, or black oxide unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention enclosures.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention enclosure connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention enclosures.

D. Inspect built-in and cast-in anchor installations, before installing detention enclosures, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

E. Inspect proprietary built-in masonry anchors to verify that anchor installations comply with requirements in Section 042000 "Unit Masonry."

F. Verify locations of detention enclosures with those indicated on Shop Drawings.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install detention enclosures plumb, rigid, properly aligned, and securely fastened in place, complying with manufacturer's written recommendations.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention enclosures to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

C. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention enclosures. Set detention enclosures accurately in

location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

D. Provide temporary bracing or anchors in formwork for items that are to be built into adjacent construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish exposed welds and surfaces smooth and blended at exposed connections so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.3 INSTALLATION OF BAR-GRILLE ASSEMBLIES

A. Wall and Ceiling Anchorage: Weld framing to continuous angles with continuous welds. Anchor angles to embedded anchors by bolting, welding.

B. Partitions: Weld adjacent framing members to each other with continuous 1/4-inch- (6-mm-) deep welds on both sides; grind smooth.

C. Doors: Install 2 inches (51 mm) above finish floor. Adjust to operate easily without binding.

3.4 INSTALLATION OF WOVEN-ROD-MESH ASSEMBLIES

A. Floor Anchorage: Fasten anchor clips to floor with 3/8-inch- (9.5-mm-) diameter bolts with double-expansion shields.

B. Wall and Ceiling Anchorage: Anchor continuous angle to walls and ceilings with 3/8-inch- (9.5-mm-) diameter, security-type, double-expansion anchor bolts with "break-off" heads, toggle bolts; weld bolt heads to angle.

1. Weld main framing to wall and ceiling angles with 1-inch (25-mm) welds at 12 inches (305 mm) o.c.

C. Weld adjacent main framing members to each other with 1/4-inch-deep by 3/4-inch- (6-mm- by 19-mm-) long welds at 12 inches (305 mm) o.c. on both sides of framing.

D. Provide supplementary framing at three-way connections and multiple-panel-height partitions. Weld main framing to supplementary framing with 1/8-inch (3-mm) fillet welds 1-inch (25 mm) long at 12 inches (305 mm) o.c. on both sides of framing.

E. Provide additional field bracing as shown or as necessary for rigid, secure installation.

F. Adjust doors to operate easily without binding.

3.5 INSTALLATION OF SECURITY GRILLES AND VENTS

A. Locations: Unless otherwise indicated, install security grilles and vents in penetrations and openings with dimensions exceeding 8 inches (203 mm) in either direction, diameter.

B. Support Frames: Set support frames in adjacent construction.

C. Field weld angle mounting frame in place from back side.

D. Field weld perimeter frames to duct sleeves.

3.6 FIELD QUALITY CONTROL

A. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification endorsed by Detention Specialist that states installed products comply with requirements in the Contract Documents.

3.7 CLEANING AND PROTECTION

A. Touchup Painting: Immediately after erection, clean bolted connections and abraded areas of shop paint, and paint exposed areas with same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Touchup Painting: Cleaning and touchup painting of bolted connections and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas; repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055963

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative mechanical grilles and frames.
2. Custom door pulls.
3. Combination hall push-button stations.

B. Related Requirements:

1. Section 057300 "Decorative Metal Railings" for decorative metal railings.
2. Section 057500 "Decorative Formed Metal" for decorative metal items made from sheet metal.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Indicate materials, finishes, fasteners, anchorages, and accessory items.

D. Patterns, Models, or Plaster Castings: For each custom casting required.

E. Samples: For each type of exposed finish.

PART 2 - PRODUCTS

2.1 DECORATIVE METAL FABRICATORS

2.2 ALUMINUM

A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Bars and Shapes: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

D. Tubing: ASTM B210 (ASTM B210M), Alloy 6063-T832.

E. Plate and Sheet: As directed ASTM B209 (ASTM B209M), Alloy 3003-H14, Alloy 5005-H32 or Alloy 6061-T6.

F. Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.3 COPPER AND COPPER ALLOYS

A. Fabricate products from alloys indicated and temper to suit application and forming methods but with strength and stiffness not less than H01 (quarter-hard) for plate, sheet, strip, and bars and H55 (light-drawn) for tube and pipe.

2.4 BRONZE

A. Extruded Shapes: ASTM B455, Alloy UNS C38500 (architectural bronze).

B. Pipe: ASTM B43, Alloy UNS C23000 (red brass, 85 percent copper).

C. Tube: ASTM B135 (ASTM B135M), Alloy UNS C23000 (red brass, 85 percent copper).

D. Castings: As directed ASTM B62, Alloy UNS C83600 (85-5-5-5 or No. 1 composition commercial red brass) or ASTM B584, Alloy UNS C86500 (No. 1 manganese bronze).

E. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

2.5 BRASS

A. Extruded Shapes: ASTM B249/B249M, Alloy UNS C36000 (free-cutting brass).

B. Seamless Tube: ASTM B135 (ASTM B135M), Alloy UNS C26000 (cartridge brass, 70 percent copper).

C. Castings: ASTM B584, Alloy UNS C85200 (high-copper yellow brass).

D. Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

2.6 NICKEL SILVER

A. Extruded Shapes: ASTM B249/B249M, Alloy UNS C79600.

B. Castings: ASTM B584, Alloy UNS C97300 (12 percent leaded nickel silver).

2.7 COPPER

A. Tube: ASTM B75/B75M, Alloy UNS C12200 (phosphorous deoxidized, high residual phosphorous copper).

B. Castings: ASTM B824, with a minimum of 99.9 percent copper.

C. Plate, Sheet, Strip, and Bars: ASTM B152/B152M, Alloy UNS C11000 (electrolytic tough pitch copper) or Alloy UNS C12200 (phosphorous deoxidized, high-residual phosphorous copper).

2.8 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304, Grade MT 316 or Grade MT 316L as directed.

B. Pipe: ASTM A312/A312M, Grade TP 304, Grade TP 316 or Grade TP 316L as directed.

C. Castings: ASTM A743/A743M, Grade CF 8 or Grade CF 20, Grade CF 8M or Grade CF 3M as directed.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304, Type 316 or Type 316L as directed.

E. Bars and Shapes: ASTM A276, Type 304, Type 316 or Type 316L as directed.

F. Wire Rope and Fittings:
   1. Wire Rope: As directed 1-by-19, 7-by-7 or 7-by-19 wire rope made from wire complying with ASTM A492, Type 316.
   2. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain without failure a load equal to minimum breaking strength of wire rope with which they are used.

2.9 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513, Type 5 (mandrel drawn).

B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M unless otherwise indicated.

E. Steel Sheet, Cold Rolled: ASTM A1008/A1008M, either commercial steel or structural steel, exposed.

2.10 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Items: As directed Aluminum, Type 304 stainless-steel or Type 316 stainless-steel fasteners.
2. Copper-Alloy (Bronze) Items: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed, muntz metal (Alloy 280) fasteners where exposed.
3. Copper-Alloy (Brass) Items: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed, brass (Alloy 260 or 360) fasteners where exposed.
4. Stainless-Steel Items: As directed Type 304 or Type 316 stainless-steel fasteners.
5. Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
6. Dissimilar Metals: As directed Type 304 or Type 316 stainless-steel fasteners.

B. Provide As directed Phillips, tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.11 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.

F. Shop Primers: As directed Provide primers that comply with Section 099113 "Exterior Painting", Section 099123 "Interior Painting" Or Section 099600 "High-Performance Coatings."

G. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

H. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

I. Shop Primer for Galvanized Steel: As directed Cementitious galvanized metal primer complying with MPI#26, Vinyl wash primer complying with MPI#80 or Water-based galvanized metal primer complying with MPI#134.

J. Intermediate Coats and Topcoats for Steel: As directed Provide products that comply with Section 099113 "Exterior Painting", Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."

K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.12 FABRICATION, GENERAL

A. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

B. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

C. Comply with AWS for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

1. As directed Where welding and brazing cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint, Type 2 Welds: completely sanded joint, some undercutting and pinholes okay, Type 3 Welds: partially dressed weld with spatter removed or Type 4 Welds: good quality, uniform undressed weld with minimal splatter.

D. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.13 DECORATIVE MECHANICAL GRILLES

A. As directed Fabricate decorative grilles from perforated aluminum, brass, bronze, stainless-steel or steel sheet or plate of thickness, size, and pattern indicated. Form perforations by punching, cutting, or drilling to produce openings of sizes and shapes indicated. Roll, press, and grind perforated metal to flatten and to remove burrs and deformations.

1. Drawings indicate perforated metal patterns required and are based on products of one manufacturer. Perforated metal patterns produced by other manufacturers may be considered, provided deviations are minor and do not change design concept as judged solely by Architect.

2.14 CUSTOM DOOR PULLS

A. As directed Fabricate custom door pulls from brass, bronze or stainless-steel bar stock of profile indicated, fabricated to shapes indicated. Form curves by bending to produce uniform curvature

of radii indicated; maintain profile of member throughout entire bend without buckling, twisting, or otherwise deforming exposed surfaces. Where radii of bends are too small to avoid buckling, grind bars after bending to restore original profile. Drill and tap door pulls to receive through bolts for attachment to doors.

B. As directed Fabricate backing plates for custom door pulls from 1/8-inch (3.2-mm) brass, bronze or stainless-steel sheet. Cut to shape indicated and bevel edges at a 45-degree angle for one-half thickness of metal. Drill and countersink holes where indicated for screws and bolts.

C. Provide units with oval-head through bolts for mounting pulls and with oval-head wood screws for mounting backing plates.

2.15 COMBINATION HALL PUSH-BUTTON STATIONS

A. As directed Fabricate units of brass, bronze or stainless steel to comply with details indicated. Coordinate with elevator signal equipment to provide integrated, closely fitted assemblies.

1. Fabricate faceplates from 1/8-inch- (3.2-mm-) thick sheet with edges beveled at a 45-degree angle for one-half thickness of metal.
2. Provide units with rectangular, split-bowl trash receptacle, designed for recess mounting in nominal 4-inch (100-mm) wall depth.
3. Provide units with emergency pictorial signs and text, complying with requirements of authorities having jurisdiction, indicating that in fire emergency, elevators should not be used and that stairways should be used instead. Engrave pictorial sign and text into front surface of faceplates to a depth of 1/16 inch (1.6 mm) with engraving painted red.
4. Provide cutouts in faceplates of units for push buttons of elevator hall push-button station, card reader, and elevator key switches.

2.16 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.17 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As directed Champagne, Light bronze, Medium bronze, Dark bronze or Black.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

G. High-Performance Organic Finish: As directed Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

2.18 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).

C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).

D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).

E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).

F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below):

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below):

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear, organic, air dried, as specified below):

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear, organic, air dried, as specified below):

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.

K. Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate), with color matching Architect's sample.

L. Statuary Conversion Coating, Bright Relieved and Lacquered: M12-C55-M2x-O6x (Mechanical Finish: matte finish, as cast; Chemical Finish: conversion coating, sulfide; Mechanical Finish: buffed, as specified; Coating: clear, organic, air dried, as specified below), with color matching Architect's sample:

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

M. Blackened, Bright Relieved, and Lacquered: M33-O60-M2x-O6x (Mechanical Finish: directionally textured, coarse satin; Coating: black, air dried; Mechanical Finish: buffed, as specified; Coating: clear, organic, air dried, as specified below), with blackening and buffing matching Architect's sample:

1. Clear, Organic Coating: Lacquer specified for copper alloys; applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

2.19 STAINLESS-STEEL FINISHES

A. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

B. Directional Satin Finish: No. 4.

C. Dull Satin Finish: No. 6.

D. Reflective, Directional Polish: No. 7.

E. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.20 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A123/A123M.

1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A153/A153M.
2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

B. Preparing Galvanized Items for Shop Priming: After galvanizing, thoroughly clean decorative metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

C. Preparing Nongalvanized Items for Shop Priming: As directed Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" or SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

D. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated ferrous-metal surfaces with universal shop primer, primers specified in Section 099113 "Exterior Painting", primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is primers specified in Section 099600 "High-Performance Coatings" are indicated.
2. Do not apply primer to galvanized surfaces.

E. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

F. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Set products accurately in location, alignment, and elevation, measured from established lines and levels.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work.

G. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

END OF SECTION 057000

SECTION 057100 - DECORATIVE METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes decorative metal stairs.

B. Related Requirements:

1. Section 057113 "Fabricated Metal Spiral Stairs."
2. Section 093013 "Ceramic Tiling" for ceramic-tile treads and landings.
3. Section 096340 "Stone Flooring" for stone treads and landings.
4. Section 096400 "Wood Flooring" for wood treads and landings.
5. Section 096613 "Portland Cement Terrazzo Flooring" Section 096623 "Resinous Matrix Terrazzo Flooring" for field-cast terrazzo treads and landings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Shop primer products.
2. Precast concrete treads.
3. Precast terrazzo treads.
4. Grout.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.

D. Samples for Verification: For each type and finish of tread.

E. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that the engineer is licensed in the jurisdiction, State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360, L/720 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor:

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304, Type 316L.

E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

G. Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

H. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316, stretcher-leveled standard of flatness.

I. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper) or Alloy UNS C23000 (red brass, 85 percent copper).

J. Brass Sheet: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

K. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 temper.

L. Titanium Sheet: ASTM B265, Grade 1.

M. Aluminum Sheet: Flat sheet complying with ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties of not less than Alloy 5005-H32.

N. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

O. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

P. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

Q. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

R. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

S. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

T. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 ABRASIVE NOSINGS

A. Cast-Metal Units: Cast iron, aluminum, bronze, nickel silver, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
   1. Configuration: Cross-hatched units, 3 inches (75 mm), 4 inches (100 mm) wide without lip.

B. Extruded Units: Aluminum, Bronze units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
   1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
   2. Provide solid-abrasive units without ribs.
   3. Nosings: Square-back units, 1-7/8 inches (48 mm), 3 inches (75 mm), 4 inches (100 mm) wide, without lip.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5, Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs, stairs indicated to be galvanized, stairs indicated to be shop primed with zinc-rich primer.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless steel bolts, ASTM F593, and nuts, ASTM F594 (ASTM F836M).

2.5 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Complying with SSPC-Paint 20, Type I-A, Type I-B, Type I-C, Type II, Level 1, 2, 3, and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 ASTM A780/A780M and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

I. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

J. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, galvanized steel, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.

K. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
2. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

L. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior, exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.6 PRECAST CONCRETE TREADS

A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.

B. Reinforcement: Galvanized, welded-wire reinforcement, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter steel wire; comply with ASTM A1064/A1064M, except for minimum wire size.

2.7 PRECAST TERRAZZO TREADS

A. Precast Terrazzo Stair Treads: Epoxy terrazzo units cast in maximum lengths possible. Comply with manufacturer's written instructions for fabricating precast terrazzo units in sizes and profiles indicated.
1. Epoxy Resin Matrix: Manufacturer's standard, recommended for use indicated.
2. Aggregates: Comply with NTMA gradation standards for mix indicated, and containing no deleterious or foreign matter.

a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.

b. 24-Hour Absorption Rate: Less than 0.75 percent.
c. Dust Content: Less than 1.0 percent by weight.

3. Reinforcement: ASTM A615/A615M, Grade 60 (Grade 420) bars, as required by unit size, profile, and thickness.
4. Abrasive Inserts: 1/2-inch- (13-mm-) wide, alundum oxide/epoxy mixture.

   a. Provide three inserts, 1/2 inch (13 mm) apart, with first insert located 1 inch (25 mm) from nosing at adjacent stair riser locations.

5. Color: As selected from manufacturer's standard color selections.
6. Finish: Honed.
7. Surface Sealer: Slip and stain-resistant, penetrating sealer that is chemically neutral with pH factor between 7 and 12; does not affect color or physical properties of terrazzo type indicated; is recommend by sealer manufacturer for use with specified terrazzo; and complies with NTMA guide specification for terrazzo type applicable for this Project.

2.8 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs in shop to greatest extent possible.

   1. Disassemble units only as necessary for shipping and handling limitations.
   2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

   1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.

2.9 FABRICATION OF STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates, steel channels, steel plates or channels, steel tubes, as indicated on Drawings.

a. Stringer Size: As required to comply with "Performance Requirements" Article, As indicated on Drawings.
b. Provide closures for exposed ends of channel, tube stringers.
c. Finish: Shop primed, Painted, Galvanized.

2. Construct platforms of steel plate, channel, plate or channel, rectangular tube, headers and miscellaneous framing members as required to comply with "Performance Requirements" Article, indicated on Drawings.

a. Provide closures for exposed ends of channel, tube, framing.
b. Finish: Shop primed, Painted, Galvanized.

3. Weld or bolt, stringers to headers; weld or bolt, framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

C. Subtreads, Risers, and Subplatforms:

1. Fabricate subtreads and subplatforms of steel plates, shapes indicated on Drawings.
2. Form subtreads, risers, and subplatforms to configurations indicated from uncoated, cold-rolled steel sheet, uncoated, hot-rolled steel sheet, galvanized steel sheet, of thickness needed to comply with performance requirements, but not less than 0.075 inch (1.9 mm) thick, of thickness indicated on Drawings.
3. Weld subtreads to stringers.

a. Locate welds on top of subtreads where they will be concealed by finished treads.

4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads.

a. Weld subplatforms to platform framing.

b. Locate welds on top of subplatforms where they will be concealed by finished flooring.
c. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.10 STAIR RAILINGS

A. Comply with applicable requirements in Section 057300 "Decorative Metal Railings."

1. Connect posts to stair framing by direct welding unless otherwise indicated.

2.11 FINISHES

A. Finish metal stairs after assembly.

B. Steel Galvanized Finish: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Steel Shop Prime Finish:

1. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning."
2. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting.

a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

D. Aluminum Finishes:

1. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

a. Color: Champagne, Light bronze, Medium bronze, Dark bronze, Black and or as directed.

E. Stainless Steel Finishes:

1. Stainless Steel Tubing Finishes:

a. 180-Grit Polished Finish: Uniform, directionally textured finish.

b. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
c. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish, to a mirror-like finish, to match Architect's sample.

2. Stainless Steel Sheet and Plate Finishes:

a. Directional Satin Finish: ASTM A480/A480M, No. 4.
b. High Luster Finish: ASTM A480/A480M, No. 7.
c. Mirror Finish: ASTM A480/A480M, No. 8.

F. Bronze Finishes:

1. Statuary Conversion Coating over Satin Finish: CDA M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.
2. Statuary Conversion Coating over Satin Finish, Lacquered: CDA M31-C55-O6x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air dried, as specified below), with color matching Architect's sample:

a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

3. Hand-Rubbed Finish, Lacquered: CDA M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

G. Brass Finishes:

1. Buffed Finish, Lacquered: CDA M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

2. Hand-Rubbed Finish, Lacquered: CDA M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

H. Copper Finishes:

1. As Fabricated: CDA M12 (Matt finish as fabricates).
2. Buffed Finish: CDA M21 (Mechanical Finish: buffed, smooth specular).
3. Hand-Rubbed Finish: CDA M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).
4. Medium-Satin Finish: CDA M32 (Mechanical Finish: directionally textured, medium satin).
5. Fine-Matte Finish: CDA M42 (Mechanical Finish: nondirectional finish, fine matte).
6. Buffed Finish, Lacquered: CDA M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

    a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

7. Hand-Rubbed Finish, Lacquered: CDA M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

    a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

8. Medium-Satin Finish, Lacquered: CDA M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear, organic, air dried, as specified below).

    a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

9. Fine-Matte Finish, Lacquered: CDA M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear, organic, air dried, as specified below).

    a. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete.
2. Center nosings on tread width.

G. Install precast concrete treads with adhesive supplied by manufacturer.

H. Install precast terrazzo treads according to manufacturer's written instructions.

3.3 REPAIRS

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 057100

SECTION 057113 - FABRICATED METAL SPIRAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fabricated spiral stairs with steel central-supporting columns and radiating treads.

B. Related Requirements:

1. Section 062023 "Interior Finish Carpentry" for wood treads.
2. Section 096513 "Resilient Base and Accessories" for resilient treads.
3. Section 096816 "Sheet Carpeting" for carpeting treads.

1.3 COORDINATION

A. Coordinate installation of anchorages for fabricated spiral stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for components.

B. Sustainable Design Submittals:

C. Shop Drawings: For fabricated spiral stairs. Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Treads.
2. Metal with painted finish.
3. Railing members.

F. Delegated-Design Submittal: For fabricated spiral stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fabricated spiral stairs.

B. Structural Performance of Stairs: Fabricated spiral stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Uniform Load: 40 lbf/sq. ft. (1.92 kN/sq. m), 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Railing Loads: Stairs shall withstand stresses resulting from railing loads in addition to loads specified above.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7: As required per the Engineer of Record

1. Handrails:

a. Uniform load of 20 lbf/ft. (0.29 kN/m), 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 20 lbf/ft. (0.29 kN/m) applied in any direction,50 lbf/ft. (0.73 kN/m) applied in any direction, 50 lbf/ft. (0.73 kN/m) applied horizontally and concurrently, with 100 lbf/ft. (1.46 kN/m) applied vertically downward.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN), 200 lbf (0.89 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
c. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Fabricated spiral stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. As required per the Engineer of Record.

1. Component Importance Factor: 1.5, 1.0.

2.3 SPIRAL STAIRS

A. Center Column: Steel or aluminum pipe welded to baseplate for anchorage to floor structure. Brace column at upper floors by means of landings attached to column and floor structure unless otherwise indicated. Provide cap for column if top is exposed.

B. Treads and Platforms: Cast aluminum, iron with integral frames, legs, and hubs.

1. Provide treads and platforms with abrasive surfaces.

C. Treads and Platforms: Steel-bar grating with welded hubs and as follows:

1. Radial grating treads.
2. Abrasive Rolled-steel, floor-plate nosings.
3. Straight flanges and welded-on legs.
4. Tapered flanges without legs.

D. Treads and Platforms: Formed steel, aluminum plate, welded to hubs or center column, and as follows:

1. Straight flanges and welded-on legs.
2. Tapered flanges without legs.
3. Pan treads without legs.
4. One-piece treads and risers, without legs.
5. Rolled-steel, floor-plate wearing surfaces.
6. Aluminum-alloy, rolled tread-plate wearing surfaces.
7. Smooth steel-plate wearing surfaces.

8. Rubber wearing surfaces.
9. Plywood subtread for covering with finish flooring specified in another Section.

E. Treads and Platforms: Steel framed, welded to hubs or center column, and without legs; wearing surface as follows:

1. Cast iron with integral abrasive.
2. Smooth steel plate with integral abrasive.
3. Wood.
4. Plywood insert for covering with finish flooring specified in another Section.

F. Railings: Uniformly bent to spiral shape and continuing at top to form guardrail around floor opening.

1. Space balusters less than 4 inches (102 mm), 4-3/8 inches (111 mm), clear.
2. Space balusters to provide one baluster per tread, and less than 21 inches (533 mm) 30 inches (762 mm), clear.
3. Space intermediate rails less than 4 inches (101 mm) 4-3/8 inches (111 mm) 21 inches (533 mm) ,clear.
4. Locate bottom rail so that a 6-inch- (152-mm-) diameter sphere cannot pass between the stair and rail.
5. Top Rail: 1-1/4- to 2-inch- (32- to 51-mm-) OD steel pipe or round tubing.
6. Top Rail: Steel of shape and size indicated.
7. Top Rail: 1-1/4- to 2-inch- (32- to 51-mm-) OD round aluminum, bronze, brass, stainless-steel tubing.
8. Top Rail: Extruded bronze of shape and size indicated.
9. Top Rail: Wood of shape and size indicated.
10. Balusters: 7/8-inch- (22-mm-) OD 1-inch- (25-mm-) OD 1-1/4-inch- (32-mm-) OD steel pipe or round tubing.
11. Balusters: 1/2-inch- (13-mm-) OD 5/8-inch- (16-mm-) OD round steel bars, tubing.
12. Balusters: 1/2-inch- (13-mm-) 5/8-inch- (16-mm-) 3/4-inch- (19-mm-) square steel bars, tubing.
13. Balusters: 5/8-inch- (16-mm-) OD 3/4-inch- (19-mm-) OD round aluminum tubing.
14. Intermediate Rails: 7/8-inch- (22-mm-) OD 1-inch- (25-mm-) OD 1-1/4-inch- (32-mm-) OD steel pipe or round tubing.
15. Intermediate Rails: Steel pipe or round tubing same size as top rail.
16. Intermediate Rails: 5/8-inch- (16-mm-) OD 3/4-inch- (19-mm-) OD round steel bars, tubing.
17. Intermediate Rails: 5/8-inch- (16-mm-) OD 3/4-inch- (19-mm-) OD 1-inch- (25-mm-) OD 1-1/4-inch- (32-mm-) OD round aluminum tubing.
18. Intermediate Rails: Round aluminum tubing same size as top rail.

2.4 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported item unless otherwise indicated.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

D. Steel Bars for Grating Treads and Platforms: ASTM A36/A36M or ASTM A1011/A1011M.

E. Wire Rod for Grating Crossbars: ASTM A510 (ASTM A510M).

F. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or Grade D.

G. Steel Pipe Columns: ASTM A53/A53M, Schedule 40. Provide Schedule 80 for columns larger than NPS 4 (DN 100) and where required to support loads.

H. Steel Pipe Railings: ASTM A53/A53M, Schedule 40.

I. Steel Tubing: Either cold-formed steel tubing complying with ASTM A500/A500M or mandrel-drawn mechanical tubing complying with ASTM A513, Type 5.

J. Iron Castings: Either gray iron complying with ASTM A48/A48M or malleable iron complying with ASTM A47/A47M unless otherwise indicated or required by structural loads.

K. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), Alloy 6061-T6.

L. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

M. Aluminum Pipe and Structural Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

N. Extruded-Aluminum Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

O. Aluminum Castings: ASTM B26/B26M, Alloy 319.0-F.

P. Extruded-Bronze Handrails: ASTM B455, Alloy UNS No. C38500 (architectural bronze).

Q. Seamless Bronze Tubing: ASTM B135 (ASTM B135M), Alloy UNS No. C23000 (red brass, 85 percent copper).

R. Seamless Brass Tubing: ASTM B135 (ASTM B135M), Alloy UNS No. C26000 (cartridge brass, 70 percent copper).

S. Stainless-Steel Tubing: ASTM A554, Grade MT 304.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: For connecting stair components and for anchoring stairs to other construction, select fasteners of the type, grade, and class required to produce connections capable of withstanding design loadings.

1. For aluminum, provide fasteners fabricated from Type 304 stainless steel.
2. For steel and cast iron, use plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.

B. Lacquer for Copper Alloys: Clear, air-drying, acrylic lacquer specially developed for coating copper-alloy products.

1. Product: Subject to compliance with requirements, provide "Incralac" developed by International Copper Research Corporation.

C. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

D. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with finish paint systems indicated.

E. Shop Primer for Galvanized Steel: Primer formulated for use over zinc-coated metal and compatible with finish paint systems indicated.

F. Shop Primer for Aluminum: Primer formulated for use over aluminum and compatible with finish paint systems indicated.

G. Wood for Stair Treads, Handrails, and Platforms: Laminated red oak, sanded to 120-grit smoothness. Apply uniform coat of manufacturer's standard clear sealer.

H. Rubber Wearing Surfaces: Manufacturer's standard, 1/4-inch- (6-mm-) thick, molded-rubber covering in pattern and color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors and patterns.

2.6 FABRICATION

A. Assemble spiral stairs in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form work true to line and level with accurate angles and surfaces.

D. Fabricate connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

E. Cut, reinforce, drill, and tap as needed to receive hardware, screws, and similar items.

F. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.

4. Finish exposed welds to comply with NOMMA Guideline 1: "Joint Finishes," for Type 1 welds: no evidence of a welded joint, Type 2 welds: completely sanded joint, some undercutting and pinholes okay, Type 3 welds: partially dressed weld with spatter removed.
5. Finish exposed surfaces smooth and blended and, except for fillet welds, so welded surface matches contours of adjoining surfaces.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.7 STEEL AND IRON FINISHES

A. Galvanized Finish: Hot-dip galvanize stairs after fabrication to comply with ASTM A123/A123M.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

D. Apply shop primer to prepared surfaces of handrails and railing components unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.8 ALUMINUM FINISHES

A. Conversion-Coated and Factory-Primed Finish: AA-C12C42R1x (cleaned with inhibited chemicals; acid chromate-fluoride-phosphate conversion coating; shop primer).

1. Apply shop primer with a minimum dry film thickness of 1.5 mils (0.04 mm).

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample As selected by Architect from manufacturer's full range and or as directed.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.
4. Reflective, Directional Polish: No. 7.
5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.10 COPPER-ALLOY FINISHES

A. Buffed Finish: Mirror polished, buffed finish.

B. Buffed Finish, Lacquered: Mirror polished, buffed finish coated with lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

C. Medium-Satin Finish, Lacquered: Directionally textured, medium satin, mechanical finish coated with lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

D. Statuary Conversion Coating over Satin Finish: Directionally textured, fine satin, mechanical finish with sulfide conversion coating.

1. Color: Match Architect's sample.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where needed for securing fabricated spiral stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, wood screws, and other connectors as required.

B. Assemble fabricated spiral stair components to comply with manufacturer's written instructions, with each component aligned and in correct relation to each other, securely anchored to the supporting column and adjacent structure.

C. Do not cut, alter, or drill stair components in the field that do not fit properly. Return components that do not fit to manufacturer for adjustment.

D. Install fabricated spiral stairs accurately in location, alignment, and elevation; level and plumb; and according to manufacturer's written instructions.

E. Install fabricated spiral stairs by welding to steel structure or to weld plates cast into concrete unless otherwise indicated.

F. Field Welding:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

3.2 CLEANING AND PROTECTION

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material.

B. For galvanized surfaces, clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

1. Paint repaired areas with same material used for shop painting.

C. Protect finished tread surfaces during construction by covering with 1/2-inch- (13-mm-) thick plywood secured with plastic strapping or another nonmarring fastening method.

END OF SECTION 057113

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aluminum decorative railings with stainless-steel wire-rope guard infill.
2. Copper-alloy decorative railings.
3. Stainless-steel decorative railings with stainless-steel wire-rope guard infill.
4. Steel and iron decorative railings with stainless-steel wire-rope guard infill.
5. Illuminated decorative railings.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
2. Section 064013 "Exterior Architectural Woodwork" Section 064023 "Interior Architectural Woodwork for wood railings.
3. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. For illuminated railings, include wiring diagrams and roughing-in details.

D. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Welded connections.
4. Brazed connections.
5. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer & testing agency.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

E. Preconstruction test reports.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.8 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as shown on Drawings.
2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage or engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner from the testing and inspecting allowance, as authorized by Change Orders or by Contractor. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E894 and ASTM E935.
3. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Decorative Railings:

B. Copper-Alloy Decorative Railings:

C. Stainless-Steel Decorative Railings:

D. Steel and Iron Decorative Railings:

E. Illuminated Decorative Railings:

F. Source Limitations: Obtain each type of railing from single source from single manufacturer.

G. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

H. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. See Section 016000 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
2. Copper Alloys: 60 percent of minimum yield strength.
3. Stainless Steel: 60 percent of minimum yield strength.
4. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg. F (67 deg. C), ambient; 180 deg. F (100 deg C), material surfaces.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B210 (ASTM B210M), Alloy 6063-T832.

E. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 5005-H32 Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

H. Perforated Metal: Aluminum sheet, ASTM B209 (ASTM B209M), Alloy 6061-T6, 0.063 inch (1.60 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching Revise pattern and wire size in "Woven-Wire Mesh" Paragraph below if required.

I. Woven-Wire Mesh: Intermediate-crimp, diamond square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch (4.1-mm) nominal diameter wire complying with ASTM B211 (ASTM B211M), Alloy 6061-T94.

2.5 COPPER ALLOYS

A. Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars and Temper H55 (light drawn) for tube and pipe.

B. Extruded Shapes, Bronze: ASTM B455, Alloy UNS C38500 (architectural bronze).

C. Extruded Shapes, Brass: ASTM B249/B249M, Alloy UNS C36000 (free-cutting brass).

D. Extruded Shapes, Nickel Silver: ASTM B249/B249M, Alloy UNS C79600.

E. Seamless Pipe, Bronze: ASTM B43, Alloy UNS C23000 (red brass, 85 percent copper).

F. Seamless Tube, Bronze: ASTM B135 (ASTM B135M), Alloy UNS C23000 (red brass, 85 percent copper).

G. Seamless Tube, Brass: ASTM B135 (ASTM B135M), Alloy UNS C26000 (cartridge brass, 70 percent copper).

H. Seamless Tube, Copper: ASTM B75/B75M, Alloy UNS C12200 (phosphorous deoxidized, high residual phosphorous copper).

I. Castings, Bronze: Composition bronze castings complying with ASTM B62, Alloy UNS C83600 (85-5-5-5 or No. 1 composition commercial red brass or sand castings complying with ASTM B584, Alloy UNS C86500 (No. 1 manganese bronze).

J. Castings, Brass: Sand castings complying with ASTM B584, Alloy UNS C85200 (high-copper yellow brass).

K. Castings, Copper: ASTM B824, with a minimum of 99.9 percent copper.

L. Castings, Nickel Silver: ASTM B584, Alloy UNS C97300 (12 percent leaded nickel silver).

M. Plate, Sheet, Strip, and Bars; Bronze: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

N. Plate, Sheet, Strip, and Bars; Brass: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

O. Plate, Sheet, Strip, and Bars; Copper: ASTM B152/B152M, Alloy UNS C11000 (electrolytic tough pitch copper) or Alloy UNS C12200 (phosphorous deoxidized, high-residual phosphorous copper).

2.6 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304, Grade MT 316, Grade MT 316L.

B. Pipe: ASTM A312/A312M, Grade TP 304, Grade TP 316, Grade TP 316L.

C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20, Grade CF 8M or CF 3M.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304, Type 316, Type 316L.

E. Bars and Shapes: ASTM A276, Type 304, Type 316, Type 316L.

F. Wire Rope and Fittings:
1. Wire Rope: 1-by-19, 7-by-7 or 7-by-19 wire rope made from wire complying with ASTM A492, Type 316.
2. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

G. Expanded Metal: ASTM F1267, Type I (expanded), Type II (expanded and flattened), Class 3 (corrosion-resisting steel), made from stainless-steel sheet complying with ASTM A666, Type 304 or Type 316 as directed.

1. Style Designation: 3/4 number 13 or 1-1/2 number 10 and or as directed.

H. Perforated Metal: Stainless-steel sheet, ASTM A240/A240M or ASTM A666, Type 304, Type 316L, 0.062 inch (1.59 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows and or as directed.

1. Basis-of-Design Product: Provide product with perforations matching

I. Woven-Wire Mesh: Intermediate-crimp, diamond or square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A580/A580M, Type 304 or Type 316.

2.7 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

E. Expanded Metal: ASTM F1267, Type I (expanded) or Type II (expanded and flattened), Class 1 (uncoated).

1. Style Designation: 3/4 number 13 or 1-1/2 number 10 and or as directed.

F. Perforated Metal: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows and or as directed.

G. Perforated Metal: Galvanized-steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch (1.63 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows with 1/8-by-1-inch (3.2-by-25.4-mm) round end slotted holes in staggered rows and or as directed.

1. Basis-of-Design Product: Provide product with perforations matching

H. Woven-Wire Mesh: Intermediate-crimp, diamond or square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A510/A510M.

2.8 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Components: Type 304 or Type 316 stainless-steel fasteners.
2. Copper-Alloy (Bronze) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed; muntz metal (Alloy 280) fasteners where exposed.
3. Copper-Alloy (Brass) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed; brass (Alloy 260 or Alloy 360) fasteners where expose.
4. Stainless-Steel Components: As directed Type 304 or Type 316 stainless-steel fasteners.
5. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
6. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.
7. Dissimilar Metals: As directed Type 304 or Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated exposed fasteners are unavoidable, exposed fasteners are the standard fastening method for railings indicated.

1. Provide Phillips tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.9 MISCELLANEOUS MATERIALS

A. Wood Rails: Clear, straight-grained hardwood rails secured to recessed exposed metal subrail.

1. Species: Ash, Cherry, Red oak, Walnut, White oak and or as directed.
2. Finish: Manufacturer's standard Transparent polyurethane, Penetrating oil, Acrylic impregnated and or as directed.
3. Staining: None, Match Architect's sample, As selected by Architect from manufacturer's full range.
4. Profile: Square, 1-3/4 by 1-3/4 inches (45 by 45 mm) with edges eased to 1/4-inch (6-mm) radius, Rectangular, 1-3/4 by 5 inches (45 by 127 mm) with edges eased to 1/4-inch (6-mm) radius, Round, 2-inch (50-mm) diameter and or as directed.

B. Wood Rails: Hardwood rails complying with Section 064023 "Interior Architectural Woodwork."

C. Electrical Components: Provide internal, fluorescent light fixtures and electrical components, required as part of illuminated railings, that comply with NFPA 70, are listed and labeled by a qualified testing agency as defined in NFPA 70, and are marked for intended location and application.

D. Plastic Handrail Caps: Thermoplastic rail covering, color as indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

F. Brazing Rods: For copper-alloy railings, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

G. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.

H. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

I. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

J. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

K. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

L. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

M. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer complying with MPI#26, Vinyl wash primer complying with MPI#80, Water-based galvanized metal primer complying with MPI#134.

N. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

O. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.

P. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.

Q. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

R. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

S. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.10 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum

amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Formwork true to line and level with accurate angles and surfaces.

F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

H. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.

I. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

J. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

K. Brazed Connections: Connect copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.

1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
2. Remove flux immediately.
3. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.

L. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

M. Form changes in direction as follows:

1. As detailed.

2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. By bending to smallest radius that will not result in distortion of railing member.

N. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

O. Close exposed ends of hollow railing members with prefabricated end fittings.

P. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

Q. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

R. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

S. For railing posts set in concrete, provide steel, stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

T. For removable railing posts, fabricate slip-fit sockets from steel, stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

U. Expanded-Metal Infill Panels: Fabricate infill panels from stainless-steel, steel expanded metal unless otherwise indicated.

1. Edge panels with U-shaped channels made from same metal as infill; not less than 0.043 inch (1.1 mm) thick.
2. Orient expanded metal with long dimension of diamonds parallel to top rail, perpendicular to top rail, horizontal, vertical.

V. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from steel, galvanized steel, aluminum, stainless steel, same metal as railings in which they are installed.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.

2. Orient perforated metal with pattern parallel to top rail, perpendicular to top rail, horizontal, vertical, as indicated on Drawings.

W. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames.

1. Make wire mesh and frames from aluminum, stainless steel, steel, unless otherwise indicated.
2. Orient wire mesh with diamonds vertical, wires perpendicular and parallel to top rail or wires horizontal and vertical or as directed.

X. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.11 ILLUMINATED RAILINGS

A. General: Comply with requirements in this Section for aluminum railings with welded connections.

B. Illuminated Units: Provide internal illumination using concealed, internally wired fluorescent-strip fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with those of the power supply provided.

1. Fluorescent Tubes: Provide number of tubes indicated or required by railing length.
2. Diffusers: UV-stabilized acrylic diffusers matching profile of railings.
3. Ballasts: Energy-saving, high power factor, Class P, electromagnetic type; designed for use with high-output lamps and with automatic-reset thermal protection. Ballasts comply with ANSI C82.1, bear Certified Ballast Manufacturer Certification labels, and are rated for zero deg. F (minus 17 deg. C), minus 20 deg. F (minus 29 deg. C) starting temperature.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.13 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Mechanical Finish: AA-M3x; sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

D. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Champagne, Light bronze, Medium bronze, Dark bronze, Black and or as directed.
2. Color: Match Architect's sample, As selected by Architect from full range of industry colors and color densities.

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range, and or as directed.

F. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

G. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604, AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

H. High-Performance Organic Finish: Three, Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50, 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range and or as directed.

2.14 COPPER-ALLOY FINISHES

A. Finish designations for copper alloys comply with the system for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

B. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).

C. Hand-Rubbed Finish: M31-M34 (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed).

D. Medium-Satin Finish: M32 (Mechanical Finish: directionally textured, medium satin).

E. Fine-Matte Finish: M42 (Mechanical Finish: nondirectional finish, fine matte).

F. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

G. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

H. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

I. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

J. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.

K. Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate) , with color matching Architect's sample.

2.15 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: ASTM A480/A480M, No. 4.

D. Dull Satin Finish: ASTM A480/A480M, No. 6.

E. Satin, Reflective, Directional Polish: ASTM A480/A480M, No. 7.

F. Mirrorlike Reflective, Nondirectional Polish: ASTM A480/A480M, No. 8.

G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

H. Sputter-Coated Finish: Titanium nitride coating deposited by magnetic sputter-coating process over indicated mechanical finish.

2.16 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior, steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A123/A123M for hot-dip galvanized railings.
4. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
5. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
6. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, but galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning." requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer, primers specified in Section 099113 "Exterior Painting", primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is primers specified in Section 099600 "High-Performance Coatings" are indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting." Section 099600 "High-Performance Coatings."

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

I. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

J. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).

4. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material attached to post with set screws.

D. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post, anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum railings, attach posts as indicated using fittings designed and engineered for this purpose.
2. For copper-alloy railings, attach posts as indicated using fittings designed and engineered for this purpose.
3. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
4. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within flanges connected to brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach handrails to walls with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt, predrilled hole for exposed bolt anchorage.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 INSTALLING PLASTIC HANDRAIL CAPS

A. Apply plastic handrail caps to top rails and handrails, where indicated, complying with manufacturer's written instructions for cutting, mounting, forming, welding, cleaning, applying end caps, and finishing.

B. Minimize number of joints in plastic caps by installing in lengths as long as possible. Allow for shortening of plastic cap caused by welding and splicing process; butt ends together to produce hairline joint.

1. Continuously weld, splice, miter, and end-cap joints using cap manufacturer's electric welding iron designed for this purpose. Remove welding flash while material is still soft.
2. Weld only prongs on underside of plastic cap at splice, miter, and end-cap joints. After cutting plastic cap, dress ends with file to produce a hairline fit between abutting sections. After mounting cap, polish top surface with cap manufacturer's solvent designed for this purpose until joint becomes almost invisible.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner, from the testing and inspecting allowance, as authorized by Change Orders.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Clean and polish glass and plastic glazing as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

D. Clean wood rails and plastic handrail caps by wiping with a damp cloth and then wiping dry.

E. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

F. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

G. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.9 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057300

SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass- and plastic-supported railings.
2. Post-supported railings with glass infill.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: As directed For professional engineer or testing agency.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

C. Preconstruction test reports.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: As directed Owner will engage or Engage a qualified testing agency to perform preconstruction testing on laboratory mockups. As directed Payment for these services will be made by Owner, from the testing and inspecting allowance, as authorized by Change Orders or by Contractor. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E894 and ASTM E935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

D. Drawn Seamless Tubing: ASTM B210 (ASTM B210M), Alloy 6063-T832.

E. Plate and Sheet: As directed ASTM B209 (ASTM B209M), Alloy 5005-H32 or Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.5 COPPER ALLOYS

A. Copper and Copper Alloys, General: Provide alloys indicated and with temper to suit application and forming methods, but with strength and stiffness not less than Temper H01 (quarter hard) for plate, sheet, strip, and bars and Temper H55 (light drawn) for tube and pipe.

B. Extruded Shapes, Bronze: ASTM B455, Alloy UNS C38500 (architectural bronze).

C. Extruded Shapes, Brass: ASTM B249/B249M, Alloy UNS C36000 (free-cutting brass).

D. Seamless Pipe, Bronze: ASTM B43, Alloy UNS C23000 (red brass, 85 percent copper).

E. Seamless Tube, Bronze: ASTM B135 (ASTM B135M), Alloy UNS C23000 (red brass, 85 percent copper).

F. Seamless Tube, Brass: ASTM B135 (ASTM B135M), Alloy UNS C26000 (cartridge brass, 70 percent copper).

G. Castings, Bronze: Composition bronze castings complying with ASTM B62, Alloy UNS C83600 (85-5-5-5 or No. 1 composition commercial red brass) or sand castings complying with ASTM B584, Alloy UNS C86500 (No. 1 manganese bronze).

H. Castings, Brass: Sand castings complying with ASTM B584, Alloy UNS C85200 (high-copper yellow brass).

I. Plate, Sheet, Strip, and Bars; Bronze: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper).

J. Plate, Sheet, Strip, and Bars; Brass: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

2.6 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304 or Grade MT 316 as directed.

B. Pipe: ASTM A312/A312M, Grade TP 304 or Grade TP 316 as directed.

C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20 or Grade CF 8M or CF 3M as directed.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A666 or ASTM A240/A240M, Type 304 or Type 316 as directed.

E. Bars and Shapes: ASTM A276, Type 304 or Type 316 as directed.

2.7 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

2.8 GLASS AND GLAZING MATERIALS

A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.

B. Tempered Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Glass Color: As directed Clear, Blue, Blue-green, Bronze, Green or Gray.
2. Thickness for Structural Glass Balusters: As required by structural loads, but not less than 12.0 or 19.0 mm as directed.
3. Thickness for Glass Infill Panels: As required by structural loads, but not less than 6.0 or 10.0 mm as directed.

C. Laminated Glass: ASTM C1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch (1.52 mm) thick.

1. Kind: LA (laminated annealed), LHS (laminated heat strengthened) or LT (laminated tempered) As indicated.
2. Glass Color: As directed Clear, Blue, Blue-green, Bronze, Green or Gray.
3. Interlayer Color: As directed Clear, Blue-green, Bronze light or Gray.

4. Interlayer Color and Pattern: As selected by Architect from manufacturer's full range, Match or Provide as directed .
5. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than 6.0 or 8.0 mm thick each.
6. Glass Plies for Glass Infill Panels: As directed Thickness required by structural loads, but not less than 3.0, 4.0 or 5.0 mm each.

D. Ceramic-Coated Glass: Heat-treated float glass, Condition C; with ceramic enamel applied by silk-screened process; complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual" and with other requirements specified.

1. Ceramic Coating Color and Pattern: As selected by Architect from manufacturer's full range, Match or Provide as directed.

E. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer as directed. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

F. Plastic Structural Glazing: Uncoated, transparent, monolithic acrylic sheet complying with ASTM D4802, Category A-1 or A-2 (cell cast or continuous cast), Finish 1 (smooth or polished), and as follows:

1. Color: As directed Colorless (clear), Blue, Blue-green, Bronze, Gray, Green or Match glass.
2. Thickness: As directed 12.0 mm or Match glass thickness.

G. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.

H. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.9 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Components: As directed Type 304 or Type 316 stainless steel fasteners.
2. Copper-Alloy (Bronze) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed; muntz metal (Alloy 280) fasteners where exposed.
3. Copper-Alloy (Brass) Components: Silicon bronze (Alloy 651 or Alloy 655) fasteners where concealed; brass (Alloy 260 or Alloy 360) fasteners where exposed.
4. Stainless Steel Components: As directed Type 304 or Type 316 stainless steel fasteners.
5. Dissimilar Metals: As directed Type 304 or Type 316 stainless steel fasteners.

B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.10 MISCELLANEOUS MATERIALS

A. Wood Rails: As directed Clear, straight-grained hardwood rails secured to recessed or exposed metal subrail.

1. Species: As directed Ash, Cherry, Red oak, Walnut or White oak.
2. Finish: As directed Manufacturer's standard, Transparent polyurethane, Penetrating oil or Acrylic impregnated.
3. Staining: As directed None, Match Architect's sample or As selected by Architect from manufacturer's full range.

B. Lacquer for Copper Alloys: Clear acrylic lacquer specially developed for coating copper-alloy products.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.11 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

C. Form changes in direction by bending or by inserting prefabricated elbow fittings.

D. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of hollow railing members with prefabricated end fittings.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

2.12 GLAZING PANEL FABRICATION

A. Structural Balusters: As directed Provide tempered, laminated, heat-strengthened or laminated, tempered glass panels for both straight and curved sections.

B. Structural Balusters: As directed Provide thermoformed, curved, plastic glazing panels for curved sections and tempered, laminated, heat-strengthened or laminated, tempered glass panels for straight sections.

C. Infill Panels: As directed Provide tempered, laminated, annealed, laminated, heat-strengthened or laminated, tempered glass panels for both straight and curved sections.

2.13 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker as directed.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker as directed.

1. Color: As directed Champagne, Light bronze, Medium bronze, Dark bronze or Black.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: As directed Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.14 COPPER-ALLOY FINISHES

A. Buffed Finish: M21 (Mechanical Finish: buffed, smooth specular).

B. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

C. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

D. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.

E. Patina Conversion Coating: M36-C12-C52 (Mechanical Finish: directionally textured, uniform; Chemical Finish: nonetched cleaned, degreased; Chemical Finish: conversion coating, ammonium sulfate), with color matching Architect's sample.

2.15 STAINLESS STEEL FINISHES

A. Directional Satin Finish: No. 4.

B. Dull Satin Finish: No. 6.

C. Satin, Reflective, Directional Polish: No. 7.

D. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout.

E. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout.

F. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

G. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.

H. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

END OF SECTION 057313

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Beam wraps.
2. Closures and trim.
3. Decorative-metal-clad, hollow-metal doors and frames.
4. Escalator enclosures.
5. Filler panels at demountable partitions between dissimilar construction.
6. Lighting coves.
7. Metal base.
8. Mullion cladding.
9. Pockets for window treatment.
10. Window stools.

B. Related Requirements:

1. Section 057000 "Decorative Metal" for decorative items made primarily from plate, bars, extrusions, tubes, castings, and other forms of metal, but which may include sheet metal components.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Samples: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

B. Evaluation Reports: For post-installed anchors, from ICC-ES.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Aluminum Sheet: Flat sheet complying with ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties of not less than Alloy 5005-H32.

C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel or forming steel.

D. Steel Sheet: As directed Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, exposed or electrolytic zinc-coated, ASTM A879/A879M, with steel sheet substrate complying with ASTM A1008/A1008M, commercial steel, exposed.

E. Stainless-Steel Sheet: As directed ASTM A240/A240M or ASTM A666, Type 304 or Type 316, stretcher-leveled standard of flatness.

F. Bronze Sheet: ASTM B36/B36M, Alloy UNS C28000 (muntz metal, 60 percent copper) or Alloy UNS C23000 (red brass, 85 percent copper).

G. Brass Sheet: ASTM B36/B36M, Alloy UNS C26000 (cartridge brass, 70 percent copper).

2.2 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in decorative formed metal and remain airtight or weathertight; as recommended in writing by decorative formed metal manufacturer.

1. ASTM D1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.

B. Sealants, Exterior: Elastomeric sealant complying with Section 079200 "Joint Sealants" and as recommended in writing by decorative formed metal manufacturer.

C. Sealants, Interior: Nonsag, paintable sealant complying with Section 079200 "Joint Sealants" and as recommended in writing by decorative formed metal manufacturer.

D. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined.

E. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated.

1. As directed Provide Phillips tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

F. Anchors: Provide fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

G. Anchor Materials:

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: As directed Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

H. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C665, Type I, and passing ASTM E136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

I. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and is noncombustible after curing.

J. Isolation Coating: As directed Manufacturer's standard alkali-resistant coating, bituminous paint or epoxy coating.

2.3 PAINTS AND COATINGS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy products.

D. Shop Primers: As directed Comply with Section 099113 "Exterior Painting", Section 099123 "Interior Painting" Or Section 099600 "High-Performance Coatings."

E. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

F. Shop Primer for Galvanized Steel: As directed Cementitious galvanized metal primer complying with MPI#26, Vinyl wash primer complying with MPI#80 or Water-based galvanized metal primer complying with MPI#134.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.

C. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

D. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

2.5 BEAM WRAPS

A. Form beam wraps from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Aluminum Sheet: 0.063 inch (1.60 mm).

a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Steel Sheet: 0.060 inch (1.52 mm).

a. Finish: As directed Factory primed, Baked enamel or Powder coat.

3. Stainless-Steel Sheet: 0.050 inch (1.27 mm).

a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

2.6 CLOSURES AND TRIM

A. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction, with weathertight joints at exterior installations.

1. Aluminum Sheet: 0.063 inch (1.60 mm).

a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Galvanized-Steel Sheet: 0.052 inch (1.32 mm).

a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

3. Steel Sheet: 0.048 inch (1.21 mm).

a. Finish: As directed Factory primed, Baked enamel or Powder coat.

2.7 DECORATIVE-METAL-CLAD DOORS AND FRAMES

A. Laminate metal sheets, of type and thickness indicated below, to faces of hollow-metal doors and frames and elevator entrances where indicated. Use adhesive that will fully bond metal to metal and that will prevent telegraphing and oil-canning.

1. Bronze Sheet: 0.040 inch (1.02 mm).

a. Finish: As directed Buffed finish, lacquered, Hand-rubbed finish, lacquered, Statuary conversion coating over satin finish, lacquered.

2. Brass Sheet: 0.040 inch (1.02 mm).

a. Finish: As directed Buffed or Hand-rubbed finish lacquered.

3. Stainless-Steel Sheet: 0.038 inch (0.95 mm).

a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

2.8 ESCALATOR ENCLOSURES

A. Form escalator enclosures from metal of type and thickness indicated below. Coordinate size of enclosures, location of cutouts, and method of attachment to adjoining construction.

1. Stainless-Steel Sheet: 0.062 inch (1.59 mm).

a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

2. Bronze Sheet: 0.081 inch (2.05 mm).

a. Finish: As directed Buffed finish, lacquered, Hand-rubbed finish, lacquered or Statuary conversion coating over satin finish.

2.9 FILLER PANELS

A. Form from two sheets of metal of type and thickness indicated below, separated by channels formed from the same material, producing a panel of same thickness as partitions or mullions unless otherwise indicated. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.

1. Galvanized-Steel Sheet: 0.064 inch (1.63 mm).

a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

2. Steel Sheet: 0.060 inch (1.52 mm).

a. Finish: As directed Factory primed, Baked enamel or Powder coat.

B. Fill interior of panel with sound-deadening insulation permanently attached to inside panel faces.

C. Adhesively attach gaskets to filler panel edges where they abut mullions or glazing.

2.10 LIGHTING COVES

A. Form lighting coves from metal of type and thickness indicated below. Coordinate size of coves, location of cutouts for electrical wiring, and method of attachment to adjoining construction.

1. Aluminum Sheet: 0.063 inch (1.60 mm).

a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Galvanized-Steel Sheet: 0.052 inch (1.32 mm).

a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

3. Steel Sheet: 0.048 inch (1.21 mm).

a. Finish: As directed Factory primed, Baked enamel or Powder coat.

4. Fabricate light coves with hairline butt joints, tapered edges for taping and spackling as directed.

2.11 METAL BASE

A. Form metal base from metal of type and thickness indicated below:

1. Aluminum Sheet: 0.063 inch (1.60 mm).

a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Stainless-Steel Sheet: 0.050 inch (1.27 mm).

a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

2.12 MULLION CLADDING

A. Form mullion cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Aluminum Sheet: 0.063 inch (1.60 mm).

    a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Galvanized-Steel Sheet: 0.052 inch (1.32 mm).

    a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

3. Stainless-Steel Sheet: 0.050 inch (1.27 mm).

    a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

2.13 POCKETS FOR WINDOW TREATMENT

A. Form pockets from metal of type and thickness indicated below, with end closures. Coordinate dimensions and attachment methods with window treatment equipment, window frames, ceiling suspension system, and other related construction to produce a coordinated, closely fitting assembly.

1. Aluminum Sheet: 0.063 inch (1.60 mm).

    a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Galvanized-Steel Sheet: 0.052 inch (1.32 mm).

    a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

3. Steel Sheet: 0.048 inch (1.21 mm).

    a. Finish: As directed Factory primed, Baked enamel or Powder coat.

2.14 WINDOW STOOLS

A. Form window stools from metal of type and thickness indicated below, with end closures:

1. Aluminum Sheet: 0.063 inch (1.60 mm).

    a. Finish: As directed Baked enamel or powder coat, Siliconized polyester, High-performance organic coating, Mill, Clear anodic or Color anodic.

2. Galvanized-Steel Sheet: 0.052 inch (1.32 mm).

a. Finish: As directed Factory primed, Baked enamel, Siliconized polyester or Powder coat.

3. Stainless-Steel Sheet: 0.050 inch (1.27 mm) or 1.3 mm.

a. Finish: As directed No. 2B, No. 4, No. 6, No. 7 or No. 8.

4. Bronze Sheet: 0.051 inch (1.29 mm).

a. Finish: As directed Buffed finish, lacquered, Hand-rubbed finish, lacquered or Statuary conversion coating over satin finish.

2.15 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker as directed.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker as directed.

1. Color: As directed Champagne, Light bronze, Medium bronze, Dark bronze or Black.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

D. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish: As directed Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As directed As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

2.16 GALVANIZED-STEEL SHEET FINISHES

A. Preparing Galvanized Items for Factory Priming: Thoroughly clean galvanized decorative formed metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

B. Preparing Galvanized Items for Factory Finishing: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Repairing Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

D. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

E. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

F. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

G. Siliconized-Polyester Coating: Immediately after cleaning and pretreating, apply manufacturer's standard epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.17 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating.

C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.18 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

D. Directional Satin Finish: No. 4.

E. Dull Satin Finish: No. 6.

F. Satin, Reflective, Directional Polish: No. 7.

G. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.19 COPPER-ALLOY FINISHES

A. Buffed Finish, Lacquered: M21-O6x (Mechanical Finish: buffed, smooth specular; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

B. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (Mechanical Finish: directionally textured, fine satin; Mechanical Finish: directionally textured, hand rubbed; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

C. Medium-Satin Finish, Lacquered: M32-O6x (Mechanical Finish: directionally textured, medium satin; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

D. Fine-Matte Finish, Lacquered: M42-O6x (Mechanical Finish: nondirectional finish, fine matte; Coating: clear, organic, air dried, as specified below).

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

E. Statuary Conversion Coating over Satin Finish: M31-C55 (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide), with color matching Architect's sample.

F. Statuary Conversion Coating over Satin Finish, Lacquered: M31-C55-O6x (Mechanical Finish: directionally textured, fine satin; Chemical Finish: conversion coating, sulfide; Coating: clear, organic, air dried, as specified below), with color matching Architect's sample:

1. Clear, Organic Coating: Lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

E. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 081113 "Hollow Metal Doors and Frames."

F. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057500

SECTION 060312 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood in the form of repairing wood features as follows:

1. Repairing wood paneling, built-in shelving, mantles, columns, railings and trim.
2. Replacing wood paneling, built-in shelving, mantles, columns, railings and trim.
3. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 080314 "Historic Treatment of Wood Doors" for historic wood door repairs, including related trim.
3. Section 080352 "Historic Treatment of Wood Windows" for historic wood window repairs, including related trim.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic wood repair and fire protection.
2. Review methods and procedures related to historic wood repair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its location in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood-repair specialist, experienced in repairing, refinishing, and replacing wood in whole and in part. Experience only in fabricating and installing new woodwork is insufficient experience for wood historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Baseboard Repair: Prepare an approximately 72-inch (2000-mm) length of baseboard to serve as mockup to demonstrate samples of each type of wood repair.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Article 1.5, "Industry Practices," of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD ITEMS

A. Replicated Wood Paneling, Built-in Shelving, Mantle, Columns, Railings and Trim: Custom-fabricated replacement wood units and components, with operating and latching hardware.
1. Wood Species: Match species of existing wood, White oak.
2. Wood Member and Trim Profiles: Match profiles and detail of existing.
3. Hardware: Reuse existing unless otherwise indicated, Match design reference sample, match existing hardware, As shown on Drawings, As required to secure hinged panel in frame.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

B. Paneling, Built-in Shelving, Mantle, Columns, Railings: Match existing species, Ponderosa pine, Ponderosa pine, eastern white pine, or Idaho white pine, Redwood, Douglas fir, African mahogany, Western red cedar.

C. Exterior Trim: Match existing species, All-heart vertical grain redwood, African mahogany.

D. Interior Trim: Match existing species, Ponderosa pine, Ponderosa pine, eastern white pine, or Idaho white pine, African mahogany.

2.4 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to featheredge.

2.5 HARDWARE

A. Hardware, General: Provide hardware required for each type of replicated or repaired wood, including but not limited to, hinges, pulls, latches, fasteners, and accessories indicated or required for proper operation. Hardware shall smoothly operate, tightly close, and secure units appropriately for frequency of use, unit weight, and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated, Nonmagnetic stainless steel, unless otherwise indicated.
2. Design: Custom hardware to replicate, Match type and appearance of existing hardware.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.6 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage caused by fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.7 WOOD FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

C. Factory-Finished Units: Alkyd Latex finish system consisting of primer and two finish coats, on exposed exterior and interior wood surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."
2. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated on Historic Structure Report or colors indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC WOOD REPAIR, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.
5. Refinish historic wood according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood by limited replacement matching existing material.

E. Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location.

3.3 WOOD PATCH-TYPE REPAIR

A. General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.

1. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood items at locations indicated on Drawings, scheduled and where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Reinstall items removed for repair into original locations.

END OF SECTION 060312

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking, cants, and nailers.
6. Wood furring and grounds.
7. Wood sleepers.
8. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent, 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness, 19 percent for 2-inch nominal (38-mm actual) thickness or less; no limit for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat all rough carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2, Construction, Stud, or No. 3, Standard, Stud, or No. 3 grade.

1. Application: All interior partitions, Interior partitions not indicated as load bearing.
2. Species:

    a. Southern pine or mixed southern pine; SPIB.
    b. Northern species; NLGA.
    c. Eastern softwoods; NeLMA.
    d. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Partitions: No. 2, Construction or No. 2, Construction, Stud, or No. 3 grade.

1. Application: Framing other than interior partitions, interior partitions not indicated as load bearing.
2. Species:

    a. Hem-fir (north); NLGA.
    b. Southern pine; SPIB.
    c. Douglas fir-larch; WCLIB or WWPA.
    d. Southern pine or mixed southern pine; SPIB.
    e. Spruce-pine-fir; NLGA.
    f. Douglas fir-south; WWPA.
    g. Hem-fir; WCLIB or WWPA.
    h. Douglas fir-larch (north); NLGA.
    i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Framing Other Than Non-Load-Bearing Partitions: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa), 1,300,000 psi (8970 MPa), 1,100,000 psi (7590 MPa), 1,000,000 psi (6900 MPa), 900,000 psi (6210 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa), 850 psi (5.86 MPa), 700 psi (4.83 MPa), 600 psi (4.14 MPa), 500 psi (3.45 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing other than interior partitions, interior partitions not indicated as load-bearing.

D. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
   1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa), 2900 psi (20.0 MPa), 2600 psi (17.9 MPa), 2250 psi (15.5 MPa) for 12-inch nominal- (286-mm actual-) depth members.
   2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 700 MPa), 1,800,000 psi (12 400 MPa), 1,500,000 psi (10 300 MPa).

B. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D5055.
   1. Web Material: Either OSB or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1, Plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1, Plywood, complying with DOC PS 1, Exterior grade.
   2. Structural Properties: Depths and design values not less than those indicated.
   3. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA-EWS standard.

C. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.

   1. Manufacturer: Provide products by same manufacturer as I-joists.
   2. Material: All-veneer product glued-laminated wood or product made from any combination solid lumber, wood strands, and veneers.
   3. Thickness: 1 inch (25 mm), 1-1/8 inches (28 mm), 1-1/4 inches (32 mm).
   4. Comply with APA PRR-401, rim board, rim board plus grade. Factory mark rim boards with APA-EWS trademark indicating thickness, grade, and compliance with APA-EWS standard.

D. Insulated Rim Boards: Insulated product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

   1. Manufacturer: Provide products by same manufacturer as I-joists.
   2. Rim Board Material: All-veneer product glued-laminated wood or product made from any combination solid lumber, wood strands, and veneers.
   3. Rim Board Thickness: 1 inch (25 mm), 1-1/8 inches (28 mm), 1-1/4 inches (32 mm).
   4. Insulation: 1-1/2-inch- (38-mm-) thick polyisocyanurate foam complying with ASTM C1289.
   5. Inside Facing: 7/16-inch- (11-mm-) thick OSB.
   6. Comply with APA PRR-401, rim board, rim board plus grade. Factory mark rim boards with APA-EWS trademark indicating thickness, grade, and compliance with APA-EWS standard.

2.6 SHEAR WALL PANELS

A. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

B. Steel-Framed Shear Wall Panels: Prefabricated assembly consisting of cold-formed galvanized-steel panel, steel top and bottom plates, and wood studs.

C. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated of basis-of-design products of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.7 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Construction or No. 2, Standard, Stud, or No. 3 grade lumber of any species.

C. Concealed Boards: 15, 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2, 3 grade; SPIB.
2. Eastern softwoods; No. 2, 3 Common grade; NeLMA.
3. Northern species; No. 2, 3 Common grade; NLGA.
4. Western woods; Construction or No. 2 Common, Standard or No. 3 Common grade; WCLIB or WWPA.

2.8 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, Exterior, C-C Plugged, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm), 3/4-inch (19-mm) nominal thickness.

2.9 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M of Type 304 stainless steel.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

2.10 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated of basis-of-design products of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.11 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Wood sleepers.
6. Utility shelving.
7. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent, 19 percent, 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness, 15 percent for 2-inch nominal (38-mm actual) thickness or less; no limit for more than 2-inch nominal (38-mm actual) thickness, 19 percent for 2-inch nominal (38-mm actual) thickness or less; no limit for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated. Items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2, Construction, Stud, or No. 3, Standard, Stud, or No. 3 grade of any species.

B. Other Framing: No. 2, Construction or No. 2, Construction, Stud, or No. 3 grade of any of the following the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Southern pine or mixed southern pine; SPIB.
5. Spruce-pine-fir; NLGA.
6. Douglas fir-south; WWPA.
7. Hem-fir; WCLIB or WWPA.
8. Douglas fir-larch (north); NLGA.
9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2, Standard, Stud, or No. 3 grade lumber of any species.

C. Utility Shelving: Lumber with 15, 19 percent maximum moisture content of eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 15, 19 percent maximum moisture content of any of the following the following species and grades:

1. Mixed southern pine or southern pine, No. 2, No. 3 grade; SPIB.
2. Eastern softwoods, No. 2, No. 3 Common grade; NELMA.
3. Northern species, No. 2, No. 3 Common grade; NLGA.
4. Western woods, Construction or No. 2 Common, Standard or No. 3 Common grade; WCLIB or WWPA.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, Exterior, C-C Plugged, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) or 3/4-inch (19-mm) nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M, of Type 304 stainless steel.

B. Screws for Fastening to Metal Framing: ASTM C1002, ASTM C954, length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061063 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood fences
2. Wood

B. Related Requirements:

1. Section 061533 "Wood Patio Decking."

1.2 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For preservative-treated wood products, from ICC-ES.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.

3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15, 19 percent.
2. Dimension Lumber: 19 percent, 19 percent for 2-inch nominal (38-mm actual) thickness or less; no limit for more than 2-inch nominal (38-mm actual) thickness.
3. Timber. 19 percent, No limit.

2.2 LUMBER

A. Dimension Lumber: Select Structural, No. 1, No. 2, Construction or No. 2 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.

B. Boards: Any of the following species and grades:

1. Douglas fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
2. Hem-fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
3. Redwood, Heart Clear, Heart B or Select Heart; RIS.
4. Southern pine, B & B finish; SPIB.
5. Western red cedar, Clear Heart, Grade A, Grade B; NLGA, WCLIB, or WWPA.

C. Boards: Any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine; No. 1, No. 2 grade; SPIB.
3. Hem-fir or hem-fir (North); Select Merchantable or No. 1 Common, Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
4. Northern white cedar, No. 1 Common, No. 2 Common; NeLMA or NLGA.
5. Spruce-pine-fir (South) or spruce-pine-fir; Select Merchantable or No. 1 Common, Construction or No. 2 Common, grade; NeLMA, NLGA, WCLIB, or WWPA.

2.3 POSTS

A. Dimension Lumber Posts: No. 2, Construction or No. 2, Construction, Stud, or No. 3 grade and any of the following species:

1. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
2. Mixed southern pine; SPIB.
3. Northern species; NLGA.

4. Eastern softwoods; NeLMA.
5. Western woods; WCLIB or WWPA.

B. Timber Posts: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), eastern hemlock tamarack (North), hem-fir, southern pine, western hemlock, or western hemlock (North); No. 1 or No. 2, NeLMA, NLGA, SPIB, WCLIB, or WWPA.

C. Timber Posts: Southern pine; No. 1, No. 2, SPIB.

2.4 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.

1. Treatment with CCA shall include post-treatment fixation process.

C. Preservative Chemicals: Acceptable to authorities having jurisdiction.

1. Do not use chemicals containing arsenic or chromium except for timber posts, except for poles, except for timber posts and poles.

D. After treatment, redry boards, dimension lumber to 19 percent maximum moisture content.

E. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

1. For items indicated to receive a stained or natural finish, mark each piece on surface that will not be exposed or omit marking and provide certificates of treatment compliance issued by inspection agency.

F. Application: Treat all wood unless otherwise indicated items indicated on Drawings.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel, fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.

B. Postinstalled Anchors: Stainless-steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as

determined by testing according to ASTM E488, conducted by a qualified independent testing and inspecting agency.

1. Stainless-steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or Grade A4).

2.6 METAL ACCESSORIES

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180), G90 (Z270), G185 (Z550) coating designation.

B. Stainless-Steel Sheet: ASTM A666, Type 304, Type 316.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install metal framing anchors to comply with manufacturer's written instructions.

D. Do not splice structural members between supports unless otherwise indicated.

E. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

F. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.
2. "Fastening Schedule" in ICC's International Building Code.
3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.

END OF SECTION 061063

SECTION 061300 - HEAVY TIMBER CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes framing using timbers and round wood poles.

1.2 DEFINITIONS

A. Timbers: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.

B. Poles: Round wood members, called either "poles" or "posts" in the referenced standards.

C. Inspection agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: Southern Pine Inspection Bureau (The).
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Sustainable Design Submittals: As directed.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of Inspection: Issued by lumber-grading agency for exposed timber not marked with grade stamp.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of materials to avoid extended on-site storage and to avoid delaying the Work.

B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 WOOD MATERIALS, GENERAL

2.2 TIMBER

A. Comply with DOC PS 20 and with grading rules of lumber-grading agencies certified by ALSC's Board of Review as applicable.

1. Factory mark each item of timber with grade stamp of grading agency.
2. For exposed timber indicated to receive a stained or natural finish, apply grade stamps to surfaces that are not exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.

B. Timber Species and Grade: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), eastern hemlock tamarack (North), hem-fir, southern pine, western hemlock, or western hemlock (North); Select Structural, No. 1, No. 2, NeLMA, NLGA, SPIB, WCLIB, or WWPA.

C. Timber Species and Grade: Alaska cedar; Select Structural, No. 1, No. 2, WCLIB.

D. Timber Species and Grade: Douglas fir-larch or Douglas fir-larch (North); Dense Select Structural, Select Structural, No. 1 Dense, No. 1, No. 2, NLGA, WCLIB, or WWPA.

E. Timber Species and Grade: Hem-fir or hem-fir (North); Select Structural, No. 1, No. 2, NLGA, WCLIB, or WWPA.

F. Timber Species and Grade: Southern pine; Dense Select Structural, Select Structural, No. 1 Dense, No. 1, No. 2 Dense, No. 2, SPIB.

G. Structural Properties: Provide any species and grade that, for moisture content provided, complies with required structural properties.

1. Allowable Stress Ratings for 12-Inch Nominal (286-mm Actual) Depth: Fb 1500 psi (10.3 MPa) and E 1,500,000 psi (10 340 MPa), Fb 1300 psi (9.0 MPa) and E 1,300,000 psi (8 960 MPa), As indicated on Drawings.

H. Moisture Content: Provide timber with 19 percent maximum moisture content at time of dressing.

I. Dressing: Provide dressed timber (S4S) timber that is rough sawn (Rgh) unless otherwise indicated.

2.3 ROUND WOOD POLES

A. Round Wood Poles: Clean-peeled wood poles complying with ASTM D3200; with at least 80 percent of inner bark removed and with knots and limbs cut flush with the surface.

B. Species: As directed.

2.4 TIMBER CONNECTORS

A. Provide bolts, 3/4 inch (19 mm) unless otherwise indicated, complying with ASTM A307, Grade A (ASTM F568M, Property Class 4.6); provide nuts complying with ASTM A563 (ASTM A563M); and, where indicated, provide flat washers.

B. Provide shear plates, 2-5/8 inches (66.7 mm) or 4 inches (102 mm) in diameter, complying with ASTM D5933 as directed.

C. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
2. Round steel bars complying with ASTM A575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.

D. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.

E. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.5 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

A. Shop fabricate members by cutting and restoring exposed surfaces to match specified surfacing. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.

B. Coat crosscuts with end sealer.

C. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Erect heavy timber framing true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

B. Fitting: Fit members by cutting and restoring exposed surfaces to match specified surfacing.

1. Predrill for fasteners using timber connectors as templates.
2. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
3. Coat crosscuts with end sealer.

C. Install timber connectors as indicated.

1. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.2 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged heavy timber framing if repairs are not approved by Architect.

END OF SECTION 061300

SECTION 061516 - WOOD ROOF DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid-sawn glued-laminated wood roof decking

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 WOOD ROOF DECKING, GENERAL

A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.2 SOLID-SAWN WOOD ROOF DECKING

A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.

B. Roof Decking Species: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), hem-fir, hem-fir (North), southern pine, spruce pine-fir (North), western hemlock, or western hemlock (North).

C. Roof Decking Species: Alaska cedar, Balsam fir, Douglas fir-larch or Douglas fir-larch (North), Eastern spruce, Hem-fir or hem-fir (North), Southern pine.

D. Roof Decking Nominal Size: 2 by 6, 2 by 8, 3 by 6, 4 by 6.

E. Roof Decking Grade: Select(ed) Decking or Select Dex, Commercial Decking or Commercial Dex.

F. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.

G. Moisture Content: Provide wood roof decking with 15, 19 percent maximum moisture content at time of dressing.

H. Face Surface: Rough sanded or wire brushed, Saw textured, Smooth.

I. Edge Pattern: Beaded edge, Bullnosed, Channel grooved, Vee grooved.

2.3 GLUED-LAMINATED WOOD ROOF DECKING

A. Face Species: Alaska cedar, Douglas fir-larch or Douglas fir-larch (North), Ponderosa pine, Southern pine, Western cedars or western cedars (North).

B. Roof Decking Nominal Size: 2 by 6, 2 by 8, 3 by 6, 3 by 8, 4 by 6, 4 by 8, 5 by 6, 5 by 8.

C. Face Grade: Custom or Supreme: Clear face is required. Occasional pieces may contain a small knot or minor characteristic that does not detract from the overall appearance.

D. Face Grade: Decorative: Sound knots and natural characteristics are allowed, including chipped edge knots, short end splits, seasoning checks, and some pin holes. Face knot holes, stains, end slits, skips, roller splits, and planer burns are not allowed.

E. Face Grade: Service: Face knot holes, stains, end splits, skips, roller splits, planer burns, and other nonstrength-reducing characteristics are allowed. Strength-reducing characteristics are not allowed.

F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.

G. Face Surface: Rough sanded or wire brushed, Saw textured, Smooth.

H. Edge Pattern: Beaded edge, Bullnosed, Channel grooved, Vee grooved.

I. Laminating Adhesive: Wet-use type complying with ASTM D2559.

2.4 ACCESSORY MATERIALS

A. Fastener Material: Hot-dip galvanized steel.

B. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install solid-sawn wood roof decking to comply with AITC 112.

1. Locate end joints for two-span continuous lay-up, combination simple and two-span continuous lay-up, controlled random lay-up, lay-up indicated.

B. Install laminated wood roof decking to comply with manufacturer's written instructions.

1. Locate end joints for two-span continuous lay-up, combination simple and two-span continuous lay-up, controlled random lay-up, lay-up indicated.
2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.

    a. Use 12d nails for 2-by-6 and 2-by-8 roof decking.
    b. Use 30d nails for 3-by-6 and 3-by-8 roof decking.
    c. Use 60d nails for 4-by-6 and 4-by-8 roof decking. Predrill roof decking to prevent splitting.
    d. Use 30d tongue nails in bottom tongue and 3/8-inch (10-mm) face spikes for 5-by-6 and 5-by-8 roof decking. Predrill roof decking at spikes to prevent splitting.

3. Slant nail each course of glued-laminated wood roof decking to the tongue of the adjacent course at 30 inches (750 mm) o.c. and within 12 inches (300 mm) of the end of each unit. Stagger nailing 15 inches (380 mm) in adjacent courses.

    a. Use 6d nails for 2-by-6 and 2-by-8 roof decking.
    b. Use 8d nails for 3-by-6 and 3-by-8 roof decking.
    c. Use 10d nails for 4-by-6 and 4-by-8 roof decking.
    d. Use 16d nails for 5-by-6 and 5-by-8 roof decking.

C. Anchor wood roof decking, where supported on walls, with bolts as indicated.

D. Apply joint sealant to seal roof decking at exterior walls at the following locations:

1. Between roof decking and supports located at exterior walls.
2. Between roof decking and exterior walls that butt against underside of roof decking.
3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.2 PROTECTION

A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

END OF SECTION 061516

SECTION 061533 - WOOD PATIO DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood decking.
2. Plastic decking.
3. Stairs for elevated decks.
4. Railings for elevated decks.
5. Wood benches for elevated decks.
6. Support framing for elevated decks.

1.2 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products, plastic decking and metal framing anchors.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood products.
2. Plastic decking.
3. Expansion anchors.
4. Metal framing anchors.
5. Decking fasteners.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency as directed.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: As directed 15 or 19 percent.
2. Dimension Lumber: As directed 19 percent or 19 percent for 2-inch nominal (38-mm actual) thickness or less; no limit for more than 2-inch nominal (38-mm actual) thickness.
3. Timber. As directed 19 percent or No limit.

2.2 WOOD DECKING

A. Dimension Lumber Decking and Stair Treads: As directed No. 2 or Construction or No. 2 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.

B. Dimension Lumber Decking and Stair Treads: As directed Deck Heart or Construction Heart or Deck Common or Construction Common redwood; RIS.

C. Board Decking and Stair Treads: As directed 1-1/4-inch (32-mm), 1-inch (25-mm) or 3/4-inch (19-mm) actual thickness radius-edged decking of any of the following species and grades:

1. Douglas fir-larch or Douglas fir-south, Patio 1 or Patio 2 as directed; WWPA.
2. Douglas fir-larch, Select Dex or Commercial Dex as directed; WCLIB.
3. Douglas fir-larch (North), Select Patio or Commercial Patio as directed; NLGA.
4. Hem-fir, Patio 1 or Patio 2 as directed; WWPA.
5. Hem-fir, Select Dex or Commercial Dex as directed; WCLIB.
6. Hem-fir (North), Select Patio or Commercial Patio as directed; NLGA.
7. Redwood, Heart Clear or Heart B or Select Heart as directed; RIS.
8. Southern pine, Premium or Standard as directed; SPIB.

9. Western red cedar, Patio 1 or Patio 2 as directed; WWPA.
10. Western red cedar, Select Dex or Commercial Dex as directed; WCLIB.
11. Western red cedar (North), Select Patio or Commercial Patio as directed; NLGA.

2.3 WOOD RAILINGS

A. Dimension Lumber Railing Members: As directed Select Structural, No. 1, No. 2, Construction or No. 2 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.
5. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.

B. Dimension Lumber Railing Members: As directed Heart Clear or Heart B or Select Heart redwood; RIS.

C. Railing Boards: Any of the following species and grades:

1. Douglas fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
2. Hem-fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
3. Redwood, Heart Clear or Heart B or Select Heart; RIS.
4. Southern pine, B & B finish; SPIB.

2.4 WOOD BENCHES

A. Dimension Lumber for Benches: As directed Select Structural or No. 1 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.
5. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.

B. Dimension Lumber for Benches: As directed Heart Clear or Heart B or Select Heart redwood; RIS.

C. Boards for Benches: Any of the following species and grades:

1. Douglas fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
2. Hem-fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
3. Redwood, Heart Clear or Heart B or Select Heart as directed; RIS.
4. Southern pine, Edge Grain B & B finish, Near Rift B & B finish or B & B finish as directed; SPIB.

2.5 DIMENSION LUMBER FRAMING

A. Deck and Stair Framing: As directed Select Structural, No. 1, No. 2, Construction or No. 2 or Construction, Stud, or No. 3 grade and any of the following species:

1. Hem-fir (North); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Spruce-pine-fir; NLGA.
5. Douglas fir-south; WWPA.
6. Hem-fir; WCLIB or WWPA.
7. Douglas fir-larch (North); NLGA.
8. Spruce-pine-fir (South); NeLMA, WCLIB, or WWPA.

B. Deck and Stair Framing: As directed Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa), 1,300,000 psi (8970 MPa), 1,100,000 psi (7590 MPa), 1,000,000 psi (6900 MPa) or 900,000 psi (6210 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa), 850 psi (5.86 MPa), 700 psi (4.83 MPa), 600 psi (4.14 MPa) or 500 psi (3.45 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

2.6 POSTS

A. Dimension Lumber Posts: As directed No. 2, Construction or No. 2, Construction, Stud, or No. 3 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.
5. Northern species; NLGA.
6. Eastern softwoods; NeLMA.
7. Western woods; WCLIB or WWPA.

B. Timber Posts: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), eastern hemlock tamarack (North), hem-fir, southern pine, western hemlock, or western hemlock (North); No. 1 or No. 2 as directed; NeLMA, NLGA, SPIB, WCLIB, or WWPA.

C. Timber Posts: Alaska cedar; As directed No. 1 or No. 2; WCLIB.

D. Timber Posts: Southern pine; As directed No. 1 or No. 2; SPIB.

2.7 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.

C. Preservative Chemicals: Acceptable to authorities having jurisdiction.

1. Do not use chemicals containing arsenic or chromium, except for timber posts.

D. Use process that includes water-repellent treatment.

E. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.

F. After treatment, as directed redry boards, dimension lumber and timber to 19 percent maximum moisture content.

G. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

1. For items indicated to receive a stained or natural finish, mark each piece on surface that will not be exposed or omit marking and provide certificates of treatment compliance issued by inspection agency.

H. Application: Treat all wood unless otherwise indicated. Treat items indicated on Drawings and the following:

1. Framing members less than 18 inches (460 mm) above grade.
2. Sills and ledgers.
3. Members in contact with masonry or concrete.
4. Posts.
5. Round wood poles.
6. Decking.
7. Stair treads.

2.8 PLASTIC DECKING

A. Plastic Lumber, General: Products acceptable to authorities having jurisdiction with current model code evaluation reports that show compliance with building code in effect for Project for indicated type of construction.

1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, shall not be less than design loads and spans indicated.

B. Composite Plastic Lumber: Solid or hollow shapes made from a mixture of cellulose fiber and polyethylene or polypropylene.
1. Decking Standard: ICC-ES AC109 or ICC-ES AC174 as directed.
2. Surface Texture: As directed Woodgrain, Smooth or Manufacturer's standard.
3. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range as directed.

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel or fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.
3. As directed For plastic or wood decking, use stainless-steel fasteners where fasteners are exposed to view.

B. Postinstalled Anchors: Stainless-steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488 conducted by a qualified independent testing and inspecting agency.

1. Stainless-steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or Grade A4).

2.10 METAL FRAMING ANCHORS

A. Allowable Design Loads: As directed Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated on Drawings, of basis-of-design products or of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180), G90 (Z270) or G185 (Z550) coating designation asidirected.

C. Stainless-Steel Sheet: ASTM A666, Type 304 or Type 316 as directed.

2.11 CONCEALED DECKING FASTENERS

A. Deck Splines: Corrosion-resistant metal or plastic splines that fit in grooves routed into the sides of decking material and are fastened to deck framing with screws. Splines provide uniform spacing of decking material.

B. Deck Clips: Black-oxide-coated, stainless-steel clips designed to be fastened to deck framing with screws, and to secure decking material with teeth that also provide uniform spacing of decking material.

C. Deck Tracks: Formed metal strips designed to be fastened to deck framing and to secure decking material from underside with screws. Made from epoxy-powder-coated, hot-dip galvanized steel or stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install wood decking and stair treads with crown up (bark side down).

D. Install plastic lumber to comply with manufacturer's written instructions.

E. Secure decking to framing with deck splines, deck clips, deck tracks or screws as directed.

F. Install metal framing anchors to comply with manufacturer's written instructions.

G. Do not splice structural members between supports unless otherwise indicated.

H. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

I. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.
2. "Fastening Schedule" in ICC's International Building Code.
3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 ELEVATED DECK JOIST FRAMING INSTALLATION

A. General: Install joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists where framed into wood supporting members by using wood ledgers as indicated or, if not indicated, by using metal joist hangers. Do not notch joists.

B. Lap members framing from opposite sides of beams or girders not less than 4 inches (102 mm,) or securely tie opposing members together.

3.3 STAIR INSTALLATION

A. Provide stair framing with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

B. Treads and Risers: As directed Secure by gluing and nailing or screwing to carriages. Countersink fastener heads, fill flush, and sand filler. Extend treads over carriages and finish with bullnose edge.

3.4 RAILING INSTALLATION

A. Balusters: As directed Fit to railings, glue, and nail or screw in place. Countersink fastener heads, fill flush, and sand filler.

B. Newel Posts: Secure to stringers and risers with through bolts, lag screws or countersunk-head wood screws and glue as directed.

C. Railings: Secure wall rails with metal brackets. Fasten freestanding railings to newel posts and to trim at walls with countersunk-head wood screws or rail bolts and glue.

END OF SECTION 061533

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated roof sheathing.
5. Subflooring.
6. Underlayment.
7. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals: As directed.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated, Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated, plywood indicated on Drawings.

2.5 WALL SHEATHING

A. Plywood Sheathing: DOC PS 1, Either DOC PS 1 or DOC PS 2, Exterior, Structural I Exterior Exposure 1, Structural I, Exposure 1 sheathing.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I, Exposure 1 sheathing.

C. Paper-Surfaced Gypsum Sheathing: ASTM C1396/C1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
   1. Type and Thickness: Regular, 1/2 inch (13 mm), Type X, 5/8 inch (15.9 mm) thick.

D. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Type and Thickness: Regular, 1/2 inch (13 mm), Type X, 5/8 inch (15.9 mm) thick.

E. Cellulose Fiber-Reinforced Gypsum Sheathing: ASTM C1278/C1278M, gypsum sheathing.

   1. Product: Subject to compliance with requirements, provide "Fiberock Sheathing with Aqua-Tough" by United States Gypsum Co.
   2. Type and Thickness: Regular, 1/2 inch (13 mm), Type X, 5/8 inch (15.9 mm) thick.

F. Cementitious Backer Units: ASTM C1325, Type A.
   1. Thickness: 1/2 inch (12.7 mm), 5/8 inch (15.9 mm), As indicated.

G. Extruded-Polystyrene-Foam Sheathing: ASTM C578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.
   1. Thickness: 3/4 inch (19 mm), 1 inch (25 mm), As indicated.
   2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

H. Foil-Faced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.
   1. Thickness: 7/16 inch (11.1 mm), 1/2 inch (13 mm), 5/8 inch (15.9 mm), 3/4 inch (19 mm), 1 inch (25 mm), As indicated.
   2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.6 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1, Either DOC PS 1 or DOC PS 2, Exterior Structural I, Exterior Exposure 1, Structural I Exposure 1 sheathing.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I, Exposure 1 sheathing.

2.7 PARAPET SHEATHING

A. Plywood Sheathing: DOC PS 1, Either DOC PS 1 or DOC PS 2, Exterior, Structural I Exterior Exposure 1, Structural I, Exposure 1 sheathing.

B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1, Structural I, Exposure 1 sheathing.

C. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Type and Thickness: Regular, 1/2 inch (13 mm), Type X, 5/8 inch (15.9 mm) thick.

D. Cementitious Backer Units: ASTM C1325, Type A.
   1. Thickness: 1/2 inch (12.7 mm), 5/8 inch (15.9 mm) As indicated.

2.8 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type V with DOC PS 2, Exposure 1 oriented strand board on one face.
   1. Polyisocyanurate-Foam Thickness: 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (50 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 3-1/2 inches (89 mm), 4 inches (102 mm).
   2. Oriented-Strand-Board Nominal Thickness: 7/16 inch (11.1 mm), 5/8 inch (15.9 mm).

B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.
   1. Polyisocyanurate-Foam Thickness: 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (50 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 3-1/2 inches (89 mm), 4 inches (102 mm).
   2. Oriented-Strand-Board Nominal Thickness: 7/16 inch (11.1 mm), 5/8 inch (15.9 mm).
   3. Spacers: Wood furring strips or blocks not less than 3/4 inch (19 mm) thick and spaced not more than 12 inches (300 mm), 16 inches (400 mm), 24 inches (600 mm) o.c.

2.9 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged Exterior, C-C Plugged Exposure 1, Structural I, Underlayment Exposure 1, Underlayment single-floor panels.

B. Oriented-Strand-Board Combination Subfloor-Underlayment: DOC PS 2, Exposure 1 single-floor panels.

C. Plywood Subflooring: DOC PS 1, Either DOC PS 1 or DOC PS 2, Exterior, Structural I Exterior, Exposure 1, Structural I, Exposure 1 single-floor panels or sheathing.

D. Oriented-Strand-Board Subflooring: DOC PS 2, Exposure 1, Structural I sheathing, single-floor panels or sheathing.

E. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior A-C, Exterior B-C, Exterior, C-C Plugged, Exposure 1 Underlayment with fully sanded face.
2. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch (15.9-mm) nominal thickness.
3. Plywood Underlayment for Carpet: DOC PS 1, Exterior, C-C Plugged, Exposure 1, Underlayment, Interior, Underlayment.
4. Particleboard Underlayment: ANSI A208.1, Grade PBU, Grade M-2.

5. Hardboard Underlayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.10 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M of Type 304 stainless steel.
2. For roof, parapet and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

2.11 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Paper-Surfaced, Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.12 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01, ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and nail, Nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Subflooring:

a. Glue and nail, Nail, Nail or staple to wood framing.
b. Screw to cold-formed metal framing.

c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Wall and Roof Sheathing:

a. Nail, Nail or staple to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:

a. Nail, Nail or staple to subflooring.
b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with nails or screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions.

B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.6 PARTICLEBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

1. Fastening Method: Glue and nail, Nail, Nail or staple underlayment to subflooring.

3.7 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: Nail, Nail or staple underlayment to subflooring.

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.
2. Wood floor trusses.
3. Wood girder trusses

1.2 ACTION SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

D. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

B. Evaluation Reports: For the following, from ICC-ES:

1. Metal-plate connectors.
2. Metal truss accessories.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction and is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Provide dry lumber with 15, 19 percent maximum moisture content at time of dressing.

B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry." Section 061053 "Miscellaneous Rough Carpentry."

2.3 METAL CONNECTOR PLATES

A. General: Fabricate connector plates to comply with TPI 1.

B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated of basis-of-design products of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.

2.6 FABRICATION

A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

F. Securely connect each truss ply required for forming built-up girder trusses.

G. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Section 061000 "Rough Carpentry." Section 061053 "Miscellaneous Rough Carpentry."
2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

H. Install wood trusses within installation tolerances in TPI 1.

I. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

J. Replace wood trusses that are damaged or do not comply with requirements.

END OF SECTION 061753

SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes framing using structural glued-laminated timber.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

B. Species and Grades for Structural Glued-Laminated Timber: Alaska cedar, Douglas fir-larch, Southern pine, any species, that complies with structural properties, combination symbols, beam stress classifications as indicated.

C. Species and Grades for Beams and Purlins:

1. Species and Beam Stress Classification: Alaska cedar, 20F-1.5E, any species, 20F-1.5E, Any species, 24F-1.7E, Douglas fir-larch, 24F-1.8E, Southern pine, 24F-1.8E.
2. Lay-up: Balanced, Either balanced or unbalanced.

D. Species and Grades for Arches:

1. Species and Beam Stress Classification: Alaska cedar, 20F-1.5E, Any species, 20F-1.5E, Any species, 24F-1.7E, Douglas fir-larch, 24F-1.8E, Southern pine, 24F-1.8E.
2. Lay-up: Balanced, Either balanced or unbalanced.

E. Species and Grades for Columns and Truss Members:

1. Species and Combination Symbol: Alaska cedar, 70, Douglas fir-larch, 1, Douglas fir-larch, 3, Southern pine, 47, Southern pine, 50.

F. Appearance Grade: Premium, Architectural Industrial Framing, complying with AITC 110.

2.2 TIMBER CONNECTORS

A. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
2. Round steel bars complying with ASTM A575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.

B. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.

C. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.3 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.4 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.

1. Predrill for fasteners using timber connectors as templates.
2. Finish exposed surfaces to remove planing or surfacing marks.
3. Coat cross cuts with end sealer.

3.2 ADJUSTING

A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.3 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior wood, medium-density overlay (MDO), primed hardboard trim.
2. Lumber, Plywood, Hardboard siding.
3. Lumber, Plywood, Hardboard soffits.

1.2 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

1.5 WARRANTY

A. Manufacturer's Warranty for Hardboard Siding Soffits and Trim: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Factory-Applied Finish: Five years from date of Substantial Completion.
2. Warranty Period for Siding Soffits and Trim (Excluding Finish): 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.2 EXTERIOR TRIM

A. Lumber Trim for Semitransparent-Stained Finish, Clear Finish, Unfinished Applications:

1. Species and Grade: Redwood; RIS Clear All Heart, Heart B, Clear, Grade B.
2. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear Heart VG (Vertical Grain), Clear Heart, Grade A, Grade B.
3. Species and Grade: Hem-fir; pressure-preservative treated; NLGA, WCLIB, or WWPA 1 Common, 2 Common.
4. Species and Grade: Southern pine; pressure-preservative treated; SPIB B & B, C & Btr D.
5. Maximum Moisture Content: 19, 15 percent with at least 85 percent of shipment at 12 percent or less.
6. Finger Jointing: Not allowed, Allowed if made with wet-use adhesive complying with ASTM D5572.
7. Face Surface: Surfaced (smooth), Saw textured.

B. Lumber Trim for Opaque-Stained, Painted Finish:

1. Species and Grade: Redwood; RIS Clear, Grade B.
2. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A, Grade B.
3. Species and Grade: Hem-fir; NLGA, WCLIB, or WWPA Prime or D finish, 1 Common, 2 Common.
4. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; NeLMA, NLGA, WCLIB, or WWPA D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).
5. Species and Grade: Northern white cedar; NeLMA or NLGA D Select, 1 Common, 2 Common.
6. Maximum Moisture Content: 19, 15 percent with at least 85 percent of shipment at 12 percent or less.

7. Finger Jointing: Not allowed, Allowed, if made with wet-use adhesive complying with ASTM D5572.
8. Face Surface: Surfaced (smooth), Saw textured.
9. Factory Priming: Factory coated on both faces and all edges, with exterior primer compatible with topcoats specified.

C. Moldings for Semitransparent-Stained Finish, Clear Finish, Unfinished Applications: MMPA WM 4, N-grade wood moldings, without finger jointing, made from kiln-dried stock to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Redwood, Western red cedar, Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
2. Brick-Mold Pattern: WWMPA WM 180, 1-1/4 by 2 inches (32 by 51 mm).
3. Drip-Cap Pattern: WWMPA WM 197, 11/16 by 1-5/8 inches (17 by 41 mm).
4. Bed-Mold Pattern: WWMPA WM 75, 9/16 by 1-5/8 inches (14 by 41 mm).
5. Screen-Bead Pattern: WWMPA WM 144, 1/4 by 3/4 inch (6 by 19 mm).

D. Moldings for Opaque-Stained, Painted Finish: MMPA WM 4, P-grade wood moldings, made from kiln-dried stock to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Redwood, Western red cedar, Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
2. Finger Jointing: Not allowed, Allowed if made with wet-use adhesive complying with ASTM D5572.
3. Factory Priming: Factory coated on both faces and all edges, with exterior primer compatible with topcoats specified.
4. Brick-Mold Pattern: WWMPA WM 180, 1-1/4 by 2 inches (32 by 51 mm).
5. Drip-Cap Pattern: WWMPA WM 197, 11/16 by 1-5/8 inches (17 by 41 mm).
6. Bed-Mold Pattern: WWMPA WM 75, 9/16 by 1-5/8 inches (14 by 41 mm).
7. Screen-Bead Pattern: WWMPA WM 144, 1/4 by 3/4 inch (6 by 19 mm).

E. MDO Trim: Exterior Grade B-B MDO plywood.

F. Primed Hardboard Trim: ANSI A135.6, primed with manufacturer's standard exterior primer. Recommended by manufacturer for exterior use.

2.3 LUMBER SIDING

A. Provide kiln-dried lumber siding complying with DOC PS 20, factory coated with exterior primer compatible with topcoats specified.

B. Species and Grade: Redwood; RIS Clear All Heart VG, Clear All Heart, Clear VG (Vertical Grain), Clear, Grade B.

C. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear VG (Vertical Grain) Heart, Grade A, Grade B.

D. Species and Grade: Spruce-pine-fir; NeLMA, NLGA, WCLIB, or WWPA 1 Common, 2 Common.

E. Species and Grade: Pressure-preservative-treated hem-fir; NLGA, WCLIB, or WWPA Prime or D finish, 1 Common, 2 Common.

F. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; NeLMA, NLGA, WCLIB, or WWPA D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).

G. Species and Grade: Northern white cedar; NeLMA or NLGA D Select, 1 Common, 2 Common.

H. Species and Grade: Pressure-preservative-treated southern pine; SPIB B & B, C & Btr, D, 1 Common, 2 Common.

I. Pattern: Bevel siding, S1S2E, actual overall dimensions of 5-1/2 by 11/16 inch (140 by 17 mm), 5-1/2 by 3/4 inch (140 by 19 mm), 7-1/4 by 3/4 inch (184 by 19 mm), 9-1/4 by 3/4 inch (235 by 19 mm), 9-1/4 by 1-3/32 inches (235 by 28 mm), measured on the face and thick edge.

J. Pattern: Drop siding, SPIB or WWPA pattern No. 105, actual face width (coverage) and thickness of 4-7/8 by 9/16 inch (124 by 14 mm), 4-7/8 by 23/32 inch (124 by 18 mm), 6-5/8 by 23/32 inch (168 by 18 mm), 8-5/8 by 23/32 inch (219 by 18 mm).

K. Pattern: V-edge, smooth-faced tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 9/16 inch (79 by 14 mm), 3-1/8 by 23/32 inch (79 by 18 mm), 5-1/8 by 23/32 inch (130 by 18 mm), 6-7/8 by 23/32 inch (175 by 18 mm).

2.4 PLYWOOD SIDING

A. Plywood Type: APA-rated siding, pressure-preservative treated, factory coated with exterior acrylic latex stain, in panel sizes indicated.

1. Face Grade: 303-OC, OL, NR, SR.
2. Face Grade: 303-6, 18, 30-S, W, S/W.

B. Thickness: 11/32 inch (8.7 mm), 3/8 inch (9.5 mm), 15/32 inch (11.9 mm), 1/2 inch (12.7 mm), 19/32 inch (15.1 mm), 5/8 inch (15.9 mm) and or As indicated.

C. Face Species: Southern pine, Douglas fir, Western red cedar, Redwood.

D. Pattern: Plain, Channel groove; grooves 4 inches (101.6 mm) o.c., Texture 1-11; grooves 4 inches (101.6 mm) o.c., Reverse board and batten; grooves 12 inches (304.8 mm) o.c.

E. Surface: Smooth, Rough sawn.

2.5 HARDBOARD SIDING

A. Hardboard Siding: ANSI A135.6, primed with manufacturer's standard exterior primer.

1. Type: 7/16-inch- (11-mm-) thick by 6-inch- (152-mm-), 8-inch- (203-mm-) wide lap siding.
2. Type: 1/2-inch- (12.7-mm-) thick by 8-inch- (203-mm-) wide, beaded-edge lap siding.

3. Type: 7/16-inch- (11-mm-) thick, shiplap-edge panels; with grooves 3-5/8 inches (92 mm) o.c., simulating wood drop siding.
4. Type: 1/2-inch- (12.7-mm-) thick, shiplap-edge panels; with grooves 5-1/2 inches (140 mm) o.c., simulating wood drop siding.
5. Type: 7/16-inch- (11-mm-) thick, square-edge flat panels; without grooves.
6. Type: 7/16-inch- (11-mm-) thick, shiplap-edge panels; channel grooved with grooves 8 inches (203 mm) o.c.
7. Texture: Smooth, Wood grain, Shingle, Stucco.

B. Colors, Textures, and Patterns: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range.

2.6 LUMBER SOFFITS

A. Provide kiln-dried lumber siding complying with DOC PS 20, factory coated with exterior primer compatible with topcoats specified.

B. Species and Grade: Redwood; RIS Clear All Heart, Clear, Grade B.

C. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A, Grade B.

D. Species and Grade: Spruce-pine-fir; NeLMA, NLGA, WCLIB, or WWPA 1 Common, 2 Common.

E. Species and Grade: Hem-fir; NLGA, WCLIB, or WWPA Prime or D finish, 1 Common, 2 Common.

F. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; NeLMA, NLGA, WCLIB, or WWPA D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).

G. Species and Grade: Northern white cedar; NeLMA or NLGA D Select, 1 Common, 2 Common.

H. Species and Grade: Southern pine; SPIB B & B, C & Btr, D, 1 Common, 2 Common.

I. Pattern: V-edge, smooth-faced tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 9/16 inch (79 by 14 mm), 3-1/8 by 23/32 inch (79 by 18 mm), 5-1/8 by 23/32 inch (130 by 18 mm), 6-7/8 by 23/32 inch (175 by 18 mm).

J. Pattern: Rounded-edge channel groove, tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 9/16 inch (79 by 14 mm), 3-1/8 by 23/32 inch (79 by 18 mm), 5-1/8 by 23/32 inch (130 by 18 mm), 6-7/8 by 23/32 inch (175 by 18 mm).

K. Pattern: Edge and center bead, tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 9/16 inch (79 by 14 mm), 3-1/8 by 23/32 inch (79 by 18 mm), 5-1/8 by 23/32 inch (130 by 18 mm), 6-7/8 by 23/32 inch (175 by 18 mm), measured at 19 percent moisture content.

L. Pattern: Beaded ceiling, tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 3/8 inch (79 by 9.5 mm), 3-1/8 by 7/16 inch (79 by 11 mm).

2.7 PLYWOOD SOFFITS

A. Plywood Type: Exterior, Grade A-C, Grade B-C, Grade C-C, plugged and touch sanded, APA-rated siding.

1. Face Grade: 303-OC, OL, NR, SR.
2. Face Grade: 303-6, 18, 30-S, W, S/W.

B. Thickness: 11/32 inch (8.7 mm), 3/8 inch (9.5 mm), 15/32 inch (11.9 mm), 1/2 inch (12.7 mm), 19/32 inch (15.1 mm) and or As indicated.

C. Face Species: Southern pine, Douglas fir, Western red cedar, Redwood.

D. Pattern: Plain, Channel groove; grooves 4 inches (101.6 mm) o.c. Texture 1-11; grooves 4 inches (101.6 mm) o.c.

E. Surface: Smooth, Rough sawn.

2.8 HARDBOARD SOFFITS

A. Hardboard Soffits: ANSI A135.6, primed with manufacturer's standard exterior primer.

1. Type: 7/16-inch- (11-mm-), 1/2-inch- (12.7-mm-) thick flat panels, smooth, wood-grain textured, stucco textured.
2. Colors, Textures, and Patterns: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range.

2.9 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails, unless otherwise indicated.
2. For redwood, provide stainless steel, hot-dip galvanized-steel fasteners.
3. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
4. For pressure-preservative-treated wood, provide stainless steel, hot-dip galvanized-steel fasteners.
5. For applications not otherwise indicated, provide stainless steel, hot-dip galvanized-steel or aluminum fasteners.

B. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

1. Horizontal Joint Flashing for Panel Siding: Preformed, galvanized-steel, aluminum prefinished-aluminum, stainless steel, Z-shaped flashing.

C. Insect Screening for Soffit Vents: Aluminum, 18-by-16-inch (1.6-by-1.4-mm) black mesh, PVC-coated glass-fiber black fabric, 18-by-14-inch (1.8-by-1.4-mm) or 18-by-16-inch (1.6-by-1.4-mm) mesh, Stainless steel, 18-by-18-inch (1.4-by-1.4-mm) mesh.

D. Continuous Soffit Vents: Aluminum hat channel shape with stamped louvers, perforations, 2 inches (51 mm) wide and in lengths not less than 96 inches (2438 mm).

1. Net-Free Area: 4 sq. in./linear ft. (280 sq. cm/m), 6 sq. in./linear ft. (420 sq. cm/m), 8 sq. in./linear ft. (560 sq. cm/m).
2. Finish: Mill finish, White paint, Brown paint.

E. Round Soffit Vents: Stamped aluminum louvered vents, 2 inches (51 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 4 inches (102 mm) in diameter, made to be inserted in round holes cut in soffit.

1. Finish: Mill finish, White paint, Brown paint.

F. Round Soffit Vents: Molded-plastic louvered vents, 2 inches (51 mm), 2-1/2 inches (64 mm), 3 inches (76 mm), 4 inches (102 mm) in diameter, made to be inserted in round holes cut in soffit.

G. Sealants: Latex, complying with ASTM C834 Type OP, Grade NF and applicable requirements in Section 079200 "Joint Sealants," and recommended by sealant and substrate manufacturers for intended application.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.

1. Cut to required lengths and prime ends.
2. Comply with requirements in Section 099113 "Exterior Painting."

3.2 INSTALLATION, GENERAL

A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.4 SIDING INSTALLATION

A. Install siding to comply with manufacturer's written instructions and warranty requirements.

B. Horizontal Lumber Siding:

1. Apply starter strip along bottom edge of sheathing or sill.
2. Install first course of siding, with lower edge at least 1/8 inch (3 mm) below starter strip and subsequent courses lapped 1 inch (25 mm) over course below.

    a. Nail at each stud.
    b. Do not allow nails to penetrate more than one thickness of siding.

3. Leave 1/8-inch (3-mm) gap at trim and corners unless otherwise recommended by manufacturer and apply sealant.
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

C. Diagonal Lumber Siding:

1. Begin application at corner, with tongue edge up.
2. Install subsequent courses with tongue-and-groove edges tightly fitted together.

    a. Nail at each stud.

3. Leave 1/8-inch (3-mm) gap at trim and corners unless otherwise recommended by manufacturer and apply sealant.

4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

D. Plywood Siding:

1. Install panels with edges over framing or blocking.
2. Nail at 6 inches (150 mm) o.c. at panel perimeter and 12 inches (300 mm) o.c. at intermediate supports unless manufacturer recommends closer spacing.
3. Leave 1/16-inch (1.5-mm) gap between adjacent panels and 1/8-inch (3-mm) gap at perimeter, openings, and horizontal joints unless otherwise recommended by panel manufacturer.
4. Seal butt joints at inside and outside corners and at trim locations.
5. Install continuous metal flashing at horizontal panel joints.
6. Apply battens and corner trim as indicated. Countersink nail heads, fill flush, and sand filler.
7. Conceal fasteners to greatest practical extent by countersinking and filling, by placing in grooves of siding pattern or by concealing with applied trim or battens as detailed.

    a. Do not nail through overlapping pieces.

E. Hardboard Siding:

1. Install hardboard siding to comply with manufacturer's written instructions.
2. Install panels with edges over framing or blocking.
3. Leave 3/16-inch (5-mm) gap at perimeter, openings, and horizontal panel joints unless otherwise recommended by panel manufacturer.
4. Seal butt joints at inside and outside corners and at trim locations.
5. Install continuous metal flashing at horizontal panel joints.
6. Apply battens and corner trim as indicated.
7. Conceal fasteners to greatest practical extent by placing in grooves of siding pattern or by concealing with applied trim or battens as detailed.

F. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.

G. Finish: Apply finish within two weeks of installation.

END OF SECTION 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Interior plywood, hardboard, board paneling.
3. Shelving and clothes rods.

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2, Grade M-2-Exterior Glue.

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: White, Black, Gray, As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range.

2.2 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Eastern white pine; NeLMA or NLGA C Select, D Select, Finish or 1 Common, Premium or 2 Common.
2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA C Select (Choice), D Select (Quality), 1 Common (Colonial), 2 Common (Sterling).
3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA C Select (Choice), D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).
4. Species and Grade: White woods; WWPA C Select, D Select, 1 Common, 2 Common.
5. Species and Grade: Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr, Prime or D finish.
6. Species and Grade: Southern pine; SPIB B & B, C & Btr finish.
7. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear Heart, Grade A, Grade B.
8. Maximum Moisture Content: 19, 15 percent with at least 85 percent of shipment at 12 percent or less.
9. Finger Jointing: Allowed, Not allowed.
10. Face Surface: Surfaced (smooth), Saw textured.

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak, White maple, Alder, Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar; NHLA Clear, A Finish, B Finish.
2. Maximum Moisture Content: 13, 10, 9.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Allowed, Not allowed, Use for lumber trim wider than 6 inches (150 mm).
5. Veneered Material: Allowed, Not allowed, Use for lumber trim wider than 6 inches (150 mm).
6. Face Surface: Surfaced (smooth), Saw textured.
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white pine; NeLMA or NLGA D Select, Finish or 1 Common, Premium or 2 Common.
2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA D Select (Quality), 1 Common (Colonial), 2 Common (Sterling).
3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).
4. Species and Grade: White woods; WWPA D Select, 1 Common, 2 Common.
5. Species and Grade: Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA Superior or C & Btr, Prime or D finish.
6. Species and Grade: Spruce-pine-fir; NeLMA, NLGA, WCLIB, or WWPA 1 Common, 2 Common.
7. Species and Grade: Alder, aspen, basswood, cottonwood, gum, magnolia, soft maple, sycamore, tupelo, or yellow poplar; NHLA A Finish, B Finish.
8. Maximum Moisture Content: 19, 15 percent with at least 85 percent of shipment at 12 percent or less.
9. Maximum Moisture Content: 13, 10, 9 percent.
10. Finger Jointing: Allowed, Not allowed.
11. Face Surface: Surfaced (smooth), Saw textured.
12. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine, Southern pine, Western red cedar, Douglas fir.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Base Pattern: WM 623, 9/16-by-3-1/4-inch (14-by-83-mm) ogee, WM 713, 9/16-by-3-1/4-inch (14-by-83-mm) ranch, WM 753, 9/16-by-3-1/4-inch (14-by-83-mm) beaded-edge, WM 620, 9/16-by-4-1/4-inch (14-by-108-mm) ogee, WM 750, 9/16-by-4-1/4-inch (14-by-108-mm) beaded-edge base.
6. Shoe-Mold Pattern: WM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round, WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round, WM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee shoe mold.
7. Casing Pattern: WM 327, 11/16-by-2-1/4-inch (17-by-57-mm) clamshell, WM 366, 11/16-by-2-1/4-inch (17-by-57-mm) featheredge, WM 376, 11/16-by-2-1/4-inch (17-by-57-mm) beaded-edge casing.
8. Mull-Casing Pattern: WM 957, 3/8-by-1-3/4-inch (9.5-by-44-mm) beaded-edge WM 973, 3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose, WM 983, 3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge casing.
9. Stop Pattern: WM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch, WM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee, WM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.

E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

1. Species: Red oak, White maple, Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Optional Material: Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
6. Base Pattern: HWM 633, 7/16-by-3-1/4-inch (11-by-83-mm) ogee, HWM 713, 7/16-by-3-1/4-inch (11-by-83-mm) ranch, HWM 753, 7/16-by-3-1/4-inch (11-by-83-mm) beaded-edge, WM 620, 7/16-by-4-1/4-inch (11-by-108-mm) ogee base.
7. Shoe-Mold Pattern: HWM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round, HWM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round, HWM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee shoe mold.
8. Casing Pattern: HWM 328, 1/2-by-2-1/4-inch (13-by-57-mm) clamshell, HWM 366, 1/2-by-2-1/4-inch (13-by-57-mm) featheredge, HWM 376, 1/2-by-2-1/4-inch (13-by-57-mm) beaded-edge casing.
9. Mull-Casing Pattern: HWM 989, 3/16-by-2-inch (5-by-51-mm) square-edge, HWM 988, 3/8-by-1-1/2-inch (9.5-by-38-mm) featheredge, HWM 987, 3/8-by-2-inch (9.5-by-51-mm) featheredge casing.
10. Stop Pattern: HWM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch, HWM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee, HWM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose stop.
11. Chair-Rail Pattern: HWM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.

F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Softwood Moldings: MMPA WM 4, P grade.

    a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
    b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

2. Hardwood Moldings: MMPA WM 4, P-grade.

    a. Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
    b. Maximum Moisture Content: 9 percent.

3. Finger Jointing: Allowed, Not allowed.
4. Optional Material: Primed MDF.
5. Base Pattern: WM 623, 9/16-by-3-1/4-inch (14-by-83-mm) ogee, WM 713, 9/16-by-3-1/4-inch (14-by-83-mm) ranch, WM 753, 9/16-by-3-1/4-inch (14-by-83-mm) beaded-edge, WM 620, 9/16-by-4-1/4-inch (14-by-108-mm) ogee, WM 750, 9/16-by-4-1/4-inch (14-by-108-mm) beaded-edge base.

6. Shoe-Mold Pattern: WM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round, WM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round, WM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee shoe mold.
7. Casing Pattern: WM 327, 11/16-by-2-1/4-inch (17-by-57-mm) clamshell, WM 366, 11/16-by-2-1/4-inch (17-by-57-mm) featheredge, WM 376, 11/16-by-2-1/4-inch (17-by-57-mm) beaded-edge casing.
8. Mull-Casing Pattern: WM 957, 3/8-by-1-3/4-inch (9.5-by-44-mm) beaded-edge, WM 973, 3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose, WM 983, 3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge casing.
9. Stop Pattern: WM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch, WM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee, WM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.

2.3 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.
1. Face Veneer Species and Cut: Rotary-cut white birch, Plain-sliced red oak, Plain-sliced hickory.
2. Veneer Matching: Random match, Selected for similar color and grain.
3. Backing Veneer Species: Same species as face veneer, Any hardwood compatible with face species.
4. Construction: Veneer core.
5. Thickness: 1/8 inch (3.2 mm), 5/32 inch (4 mm), 3/16 inch (5 mm), 1/4 inch (6.4 mm), 5/16 inch (7.9 mm), 7/16 inch (11 mm).
6. Panel Size: 48 by 96 inches (1219 by 2438 mm), 48 by 120 inches (1219 by 3048 mm).
7. Panel Size: 1200 by 2400 mm, 1200 by 3000 mm.
8. Glue Bond: Type II (interior).
9. Face Pattern: Manufacturer's standard V, channel-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random-width boards.
10. Finish: Manufacturer's standard, transparent, UV-resistant, protective finish, As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range.

B. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.
1. Thickness: 1/8 inch (3.2 mm), 5/32 inch (4 mm), 1/4 inch (6.4 mm).
2. Finish: Class I, Class II.
3. Surface-Burning Characteristics: As follows, tested according to ASTM E84:

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

4. Colors, Textures, and Patterns: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range.

C. Board Paneling: Interior wood-board paneling complying with MMPA WM 9.

1. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine, Southern pine, Western red cedar, Figured red gum.
2. Grade: Clear No. 1, Clear No. 2, Knotty No. 1, Knotty No. 2, Finger jointed.
3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less, 9 percent.
4. Pattern: V-joint, tongue and groove, PT 82, Beaded ceiling, PT 85, Beveled-edge channel, shiplapped, PT 82, and or as indicated.
5. Net Coverage Width: Not less than 5-1/16 inches (128 mm), 6-3/4 inches (171 mm), 8-3/4 inches (222 mm).

D. Board Paneling:

1. Species and Grade: Eastern white pine; NeLMA or NLGA, C Select, D Select, Finish or 1 Common, Premium or 2 Common.
2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA, C Select (Choice), D Select (Quality), 1 Common (Colonial), 2 Common (Sterling).
3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA, C Select (Choice), D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).
4. Species and Grade: Southern pine; SPIB, B & B, C & Btr, No. 2, Paneling.
5. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA, Clear Heart, Grade A, Grade B.
6. Maximum Moisture Content: 19, 15, percent with at least 85 percent of shipment at 12 percent or less.
7. Pattern: V-joint, tongue and groove, NeLMA EWP 4, SPIB SPP 54 or WWPA WP 4.
8. Pattern: Pickwick, tongue and groove, NeLMA EWP 2, SPIB SPP 52 or WWPA WP 2.
9. Pattern: Rounded-edge channel groove, tongue and groove, SPIB SPP 60 or WWPA WP 6.
10. Pattern: Edge and center bead, tongue and groove, NeLMA E & CB or WWPA E & CB Ceiling.
11. Net Coverage Width: Not less than 5-1/16 inches (128 mm), 6-3/4 inches (171 mm), 8-3/4 inches (222 mm).

2.4 SHELVING AND CLOTHES RODS

A. Exposed, Closet, Utility Shelving: Made from the following material, one of the following materials, 3/4 inch (19 mm) thick:

1. Particleboard with radiused and filled or solid-wood front edge.
2. MDF with radiused or solid-wood front edge.
3. MDO softwood plywood with solid-wood edge.
4. Melamine-faced particleboard with radiused and filled, applied-PVC front edge.
5. Wood boards as specified above for lumber trim for opaque, softwood lumber trim for transparent, hardwood lumber trim for transparent finish.
6. Softwood Boards: Kiln-dried eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA, C Select (Choice), D Select (Quality), Finish or 1 Common (Colonial), Premium or 2 Common (Sterling).

7. Softwood Boards: Kiln-dried Douglas fir-larch, Douglas fir south, or hem-fir; SPIB Superior or C & Btr, Prime or D, finish; NLGA, WCLIB, or WWPA; or southern pine; B & B, C finish.

B. Shelf Cleats: 3/4-by-3-1/2-inch (19-by-89-mm) boards, 3/4-by-5-1/2-inch (19-by-140-mm) boards, 3/4-by-5-1/2-inch (19-by-140-mm) boards with hole and notch to receive clothes rods, as specified above for shelving, lumber trim for opaque finish softwood lumber trim for transparent finish hardwood lumber trim for transparent finish.

C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.

E. Standards for Adjustable Shelf Brackets: BHMA A156.9, B04102; powder-coat-finished, brass-finished, zinc-plated steel.

F. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel, brass-finished steel, zinc-plated steel, bronze-anodized aluminum, black-anodized aluminum, natural aluminum.

G. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; powder-coat-finished, brass-finished, zinc-plated steel.

H. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; powder-coat-finished, brass-finished, zinc-plated steel.

I. Clothes Rods: 1-1/2-inch- (38-mm-) diameter, clear, kiln-dried hardwood, Douglas fir or southern pine.

J. Clothes Rods: 1-5/16-inch- (33-mm-) diameter, aluminum tubes, chrome-plated-steel tubes, color-coated-steel tubes, stainless steel tubes, chrome-plated-steel telescoping tubes with end brackets for mounting on shelf cleats.

K. Rod Flanges: Clear, kiln-dried, Douglas fir or southern pine, eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine, red oak, white maple, aspen, basswood, cottonwood, sap gum, white maple, or yellow poplar, turnings with clear finish.

L. Rod Flanges: Aluminum, Chrome-plated steel, Stainless steel.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Low-Emitting Materials: Adhesives shall comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

D. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

E. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.
3. Cope, Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.

8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 PANELING INSTALLATION

A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.

1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
2. Install with uniform tight joints between panels.
3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
4. Space fasteners and adhesive as recommended by panel manufacturer.
5. Conceal fasteners to greatest practical extent.
6. Arrange panels with grooves and joints over supports.

    a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
    b. Use fasteners with prefinished heads matching groove color.

B. Hardboard Paneling: Install according to manufacturer's written instructions.

1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
2. Butt adjacent panels with moderate contact.
3. Use fasteners with prefinished heads matching paneling color.
4. Wood Stud or Furring Substrate: Install with 1-inch (25-mm) annular-ring shank hardboard nails.
5. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch (41-mm) annular-ring shank hardboard nails.
6. Nailing: Space nails 4 inches (100 mm) o.c. at panel perimeter and 8 inches (200 mm) o.c. at intermediate supports unless otherwise required by manufacturer.

C. Board Paneling: Install according to manufacturer's written instructions.

1. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
2. Install in full lengths without end joints.
3. Stagger end joints in random pattern to uniformly distribute joints on each wall.
4. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
5. Install with uniform end joints. Locate end joints only over furring or blocking.
6. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
7. Install with uniform tight joints between boards.
8. Fasten paneling by face nailing, setting nails, and filling over nail heads.
9. Fasten paneling with trim screws, set below face and filled.
10. Fasten paneling by blind nailing through tongues.
11. Fasten paneling with paneling system manufacturer's concealed clips.

12. Fasten paneling to gypsum wallboard with panel adhesive.

3.5 SHELVING AND CLOTHES ROD INSTALLATION

A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.

1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
2. Space fasteners not more than 16 inches (400 mm) o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.
3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
4. Remove adhesive that is squeezed out after fastening shelf cleats in place.

B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches (800 mm), 36 inches (900 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches (300 mm) o.c.

D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.

1. Install shelves, fully seated on cleats, brackets, and supports.
2. Fasten shelves to cleats with finish nails or trim screws, set flush.
3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

F. Install rod flanges for rods as indicated.

1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
2. Install rods in rod flanges.

END OF SECTION 062023

SECTION 064013 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior standing and running trim.
2. Exterior frames and jambs.
3. Exterior stairs and railings.
4. Wood furring, blocking, shims, and hanging strips for installing exterior architectural woodwork items that are not concealed within other construction.
5. Shop priming of exterior architectural woodwork.
6. Shop finishing of exterior architectural woodwork.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Wood-Preservative Treatment:

a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
b. Indicate type of preservative used and net amount of preservative retained.
c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

2. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and attachment details.
2. Show large-scale, full-size, details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

4. Apply AWI Quality Certification, WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer and Installer.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program WI's Certified Compliance Program.

B. Installer Qualifications: Fabricator of products, Licensed participant in AWI's Quality Certification Program, Licensed participant in WI's Certified Compliance Program.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical exterior architectural woodwork as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of exterior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI, WI certification program indicating that woodwork and installation complies with requirements of grades specified.

    a. This project has been registered with AWI as AWI Quality Certification Program Number.
    b. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 800-345-0991.

2.3 EXTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Wood Species: All-heart redwood, Western red cedar, Ponderosa pine or sugar pine, Eastern white pine.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 9 to 15, 10 to 15, 7 to 12 percent.

2.4 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Backout or groove backs of flat trim members, and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Wood Species: All-heart redwood, Western red cedar, Ponderosa pine or sugar pine, Eastern white pine, sugar pine, or western white pine, Any closed-grain hardwood.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 9 to 15, 10 to 15, 7 to 12 percent.

2.5 EXTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Wood Species: Teak, All-heart redwood, Western red cedar, White oak, Ponderosa pine or sugar pine.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 9 to 15, 10 to 15, 7 to 12 percent.

2.6 EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Wood Species: All-heart redwood, Western red cedar, Ponderosa pine, Ponderosa pine or sugar pine, Eastern white pine, sugar pine, or western white pine, Any closed-grain hardwood.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 9 to 15, 10 to 15, 7 to 12 percent.

2.7 EXTERIOR STAIRS AND RAILINGS

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Hand select wood for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

C. Stair Treads: 1-1/4-inch- (32-mm-), 1-inch- (25-mm-) thick, kiln-dried, pressure-preservative-treated stepping with half-round or rounded edge nosing, of any of the following:

1. Douglas fir, NLGA, WCLIB, or WWPA C & Btr VG (Vertical Grain) stepping.
2. Hem-fir, NLGA, WCLIB, or WWPA C & Btr VG (Vertical Grain) stepping.
3. Southern pine, SPIB B & B stepping.

D. Stair Treads: 1-1/4-inch- (32-mm-), 1 inch- (25 mm-) actual thickness, kiln-dried with half-round or rounded edge nosing.

1. Redwood, RIS Deck Heart or Construction Heart, Deck Common or Construction Common.
2. Redwood, RIS Heart Clear, Heart B or Select Heart.
3. Western red cedar, WWPA Patio 1, Patio 2.
4. Western red cedar, WCLIB Select Dex, Commercial Dex.
5. Western red cedar (North), NLGAS Select Patio, Commercial Patio.

E. Stair Treads: 1-1/4-inch- (32-mm-), 1-inch- (25-mm-), 3/4-inch- (19-mm-), actual thickness radius-edged S4S boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: Ipe, Teak, Cumaru, Garapa, Goncalo alves.
2. Grade Characteristics:

a. Clear one face; small pin knots and worm holes allowed on back face.
b. Sound; small pin knots, worm holes, and fixed knots allowed.
c. All heart one face.
d. Straight grained and parallel cut.
e. Free of heart centers.
f. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wane.
g. No discoloration.

F. Stair Risers: 3/4-inch- (19-mm-) thick, kiln-dried, pressure-preservative-treated finish boards, of any of the following:

1. Douglas fir, NLGA, WCLIB, or WWPA C & Btr or Superior finish.
2. Hem-fir, NLGA, WCLIB, or WWPA C & Btr or Superior finish.
3. Southern pine, SPIB B & B.

G. Stair Risers: 3/4-inch- (19-mm-) actual thickness, kiln-dried with half-round or rounded edge nosing.

1. Redwood, RIS Deck Heart or Construction Heart, Deck Common or Construction Common.
2. Redwood, RIS Heart Clear, Heart B or Select Heart.
3. Western red cedar, WWPA Patio 1, Patio 2.
4. Western red cedar, WCLIB Select Dex, Commercial Dex.
5. Western red cedar (North), NLGAS Select Patio, Commercial Patio.

H. Stair Risers: 3/4-inch- (19-mm-) actual thickness radius-edged S4S boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: Ipe, Teak, Cumaru, Garapa, Goncalo alves.
2. Grade Characteristics:

    a. Clear one face; small pin knots and worm holes allowed on back face.
    b. Sound; small pin knots, worm holes, and fixed knots allowed.
    c. All heart one face.
    d. Straight grained and parallel cut.
    e. Free of heart centers.
    f. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wane.
    g. No discoloration.

I. Railing Members: Clear, kiln-dried, solid, yellow poplar, pressure-preservative-treated Douglas fir, pressure-preservative-treated southern pine; railing stock of pattern indicated on Drawings.

J. Railing Members: Select Structural, No. 1, No. 2, Construction or No. 2 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.
5. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.

K. Railing Members: Redwood, RIS Heart Clear, Heart B or Select Heart.

L. Railing Members: Any of the following species and grades:

1. Douglas fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
2. Hem-fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
3. Redwood, RIS Heart Clear, Heart B or Select Heart.

4. Southern pine, SPIM B & B finish.

M. Railing Members: Radius-edged Ipe, Teak S4S boards, same grade as stair treads, clear, clear all heart , straight grained and parallel cut.

N. Balusters: 1-1/16-inch- (27-mm-) square, clear, kiln-dried, solid, yellow poplar, pressure-preservative-treated Douglas fir, pressure-preservative-treated southern pine.

O. Balusters: 1-1/16-inch- (27-mm-) square, Select Structural, No. 1, No. 2, Construction or No. 2 grade, and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.
5. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.

P. Balusters: 1-1/16-inch- (27-mm-) square, redwood, RIS Heart Clear, Heart B or Select Heart.

Q. Balusters: 1-1/16-inch- (27-mm-) square, and any of the following species and grades:

1. Douglas fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
2. Hem-fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
3. Redwood, RIS, Heart Clear or Heart B or Select Heart as directed.
4. Southern pine, SPIM B & B finish.

R. Balusters: 1-1/16-inch- (27-mm-) square, radius-edged Ipe, Teak, S4S boards, same grade as stair treads, clear, clear all heart, straight grained and parallel cut.

S. Newel Posts: 2-3/4-inch- (70-mm-) square, clear, kiln-dried, yellow poplar, pressure-preservative-treated Douglas fir, pressure-preservative-treated southern pine, turned newel posts of pattern and size indicated on Drawings.

T. Newel Posts: 2-3/4-inch- (70-mm-) square, Select Structural, No. 1, No. 2, Construction or No. 2, grade, and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.
4. Redwood; RIS.
5. Spruce-pine-fir or spruce-pine-fir (South); NeLMA, NLGA, WCLIB, or WWPA.

U. Newel Posts: 2-3/4-inch- (70-mm-) square, redwood, RIS Heart Clear, Heart B or Select Heart.

V. Newel Posts: 2-3/4-inch- (70-mm-) square, and any of the following species and grades:

1. Douglas fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
2. Hem-fir, NLGA, WCLIB, or WWPA C & Btr finish or C Select.
3. Redwood, RIS, Heart Clear or Heart B or Select Heart as directed.

4. Southern pine, SPIM B & B finish.

W. Newel Posts: 2-3/4-inch- (70-mm-) square, radius-edged Ipe, Teak, S4S boards, same grade as stair treads, clear, clear all heart, straight grained and parallel cut.

2.8 WOOD MATERIALS

A. Hardboard: ANSI A135.4.

B. Softwood Plywood: DOC PS 1, exterior, medium-density overlay.

2.9 PRESERVATIVE-TREATED-WOOD MATERIALS

A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with a compatible EPA-registered insecticide.
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative-Treated Wood Materials: Treat wood materials unless otherwise indicated on Drawings, except items indicated to be fire-retardant treated.

1. Items fabricated from the following wood species need not be treated:

a. Redwood, All-heart redwood.
b. Western red cedar, All-heart western red cedar.
c. White oak.
d. African mahogany.
e. Honduras mahogany.
f. Ipe.
g. Dark red meranti.
h. Teak.

2.10 FIRE-RETARDANT-TREATED WOOD MATERIALS

A. Fire-Retardant-Treated Wood Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards for the grade specified. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Exterior Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84 after being subjected to accelerated weathering according to ASTM D2898, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Extent of Fire-Retardant-Treated Wood Materials:

1. Exterior architectural woodwork located more than 40 feet (12.192 m) above grade.
2. Exterior architectural woodwork in locations with a fire-separation distance of 5 feet (1.524 m) or less.
3. Where indicated on Drawings.

2.11 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel, fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329/F2329M unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use brass/bronze, stainless steel, hot-dip galvanized-steel fasteners.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.

G. Postinstalled Anchors: Stainless steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4).

2.12 MISCELLANEOUS MATERIALS

A. Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

1. Wood-Preservative Treatment: By pressure process, AWPA U1; Use Category UC3b.

a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2. Fire-Retardant Treatment: Complying with requirements; provide where indicated on Drawings.

2.13 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate exterior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.14 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Exterior Architectural Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer as specified in Section 099113 "Exterior Painting."

D. Exterior Architectural Woodwork for Transparent Finish:

1. Shop seal surfaces to be concealed
2. Shop seal exposed surfaces with stain (if specified), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

2.15 SHOP FINISHING

A. Finish exterior architectural woodwork with transparent finish, indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing exterior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of exterior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish: Comply with Section 099300 "Staining and Transparent Finishing."

D. Opaque Finish: Comply with Section 099113 "Exterior Painting."

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition exterior architectural woodwork to average prevailing humidity conditions at Project site.

B. Before installing exterior architectural woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Grade: Install exterior architectural woodwork to comply with same grade as item to be installed.

B. Assemble exterior architectural woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install exterior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 36 inches (900 mm), 60 inches (1500 mm), 96 inches (2400 mm) long , except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.

E. Scribe and cut exterior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Preservative-Treated Wood Materials: Where field cut or drilled, treat cut ends and drilled holes according to AWPA M4.

G. Fire-Retardant-Treated Wood Materials: Install fire-retardant-treated materials to comply with chemical treatment manufacturer's written instructions.

H. Anchor exterior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with exterior architectural woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

I. Stair and Railing Installation:

1. Treads and Risers:

a. Install stair tread with crown side up (bark side down).
b. Secure treads and risers by gluing and nailing to carriages.

1) Extend treads over carriages and finish with bullnose edge.

c. Countersink nail heads, fill flush, and sand filler.

2. Balusters:

a. Fit balusters to treads, glue, and nail in place.
b. Countersink nail heads, fill flush, and sand filler.
c. Let into railings and glue in place.

3. Newel Posts: Secure newel posts to stringers and risers with through bolts, lag screws, countersunk-head wood screws and glue.
4. Railings:

a. Secure wall rails with metal brackets.
b. Fasten freestanding railings to newel posts and to trim at walls with glue and countersunk-head wood screws or rail bolts.

5. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
6. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (10-mm) variation between largest and smallest treads and risers within each flight.

J. Touch up finishing work specified in this Section after installation of exterior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

K. Field Finishing: See Section 099113 "Exterior Painting" and Section 099300 "Staining and Transparent Finishing" for final finishing of installed exterior architectural woodwork.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program, WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064013

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Interior frames and jambs.
3. Interior stairs and railings.
4. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
5. Shop priming of interior architectural woodwork.
6. Shop finishing of interior architectural woodwork.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.
4. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include the following:

    a. Dimensioned plans, elevations, and sections.
    b. Attachment details.

2. Show large-scale, full-size details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Apply AWI Quality Certification, WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each shop-applied color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For architectural woodwork manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. Adhesives.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTLAS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program, WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program, WI's Certified Compliance Program.

1. Installer Qualifications: Manufacturer of products and Licensed participant in AWI's Quality Certification Program, Licensed participant in WI's Certified Compliance Program.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical interior architectural woodwork as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55, 43 and 70, 17 and 50 percent during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI, WI certification program indicating that woodwork and installation complies with requirements of grades specified.

    a. This project has been registered with AWI as AWI Quality Certification Program Number.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Hardwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Species: Red oak, White oak, White ash, Hickory.
3. Cut: Plain sliced/plain sawn, Rift cut/rift sawn, Quarter cut/quarter sawn.
4. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.
5. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
6. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.

    a. For veneered base, use hardwood lumber core, glued for width.

7. For base wider than available lumber, glue for width. Do not use veneered construction.
8. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

C. Softwood Lumber:

1. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
2. Species: Eastern white pine, Sugar pine, Western white pine, Douglas fir.

3. Cut: Plain sawn.
4. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.
5. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
6. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.

    a. For veneered base, use softwood lumber core, glued for width.

7. For base wider than available lumber, glue for width. Do not use veneered construction.
8. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.
9. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

1. Wood Species: Any closed-grain hardwood, Eastern white pine, sugar pine, or western white pine.
2. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.

2.5 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Species: Red oak, White oak, White ash, Hickory.
2. Cut: Plain sliced/plain sawn, Rift cut/rift sawn, Quarter cut/quarter sawn.
3. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.
4. Provide split species on frames and jambs that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

2.6 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Wood Species: Any closed-grain hardwood, Eastern white pine, sugar pine, or western white pine.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.
2. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.

2.7 INTERIOR WOOD STAIRS AND RAILINGS

A. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

B. Wood for Transparent Finish:

1. Species and cut:

a. Stringers: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
b. Risers: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
c. Treads: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
d. Railings: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
e. Balusters: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
f. Newels: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.
g. Moldings: Red oak, plain sawn, Red oak, quarter sawn, Hard maple, plain sawn.

2. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.

C. Wood for Opaque Finish:

1. Species: Any closed-grain hardwood, Eastern white pine, sugar pine, or western white pine, Any closed-grain hardwood, except that eastern white pine, sugar pine, or western white pine may be used for risers, stringers, and moldings.
2. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.

D. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D2559, and with the following allowable design values as determined according to ASTM D5456:

1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa), 2900 psi (20.0 MPa), 2600 psi (17.9 MPa), 2250 psi (15.5 MPa) for 12-inch nominal- (286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa), 1,800,000 psi (12 400 MPa), 1,500,000 psi (10 300 MPa).

E. Rough Carriages for Stairs: Select Structural, No. 1, No. 2, grade, kiln-dried to 15 percent maximum moisture content:

1. Acceptable Species:

a. Hem-fir (north).
b. Southern pine.
c. Douglas fir-larch.
d. Douglas fir-larch (north).
e. Spruce-pine-fir.
f. Hem-fir.

g. Douglas fir-south.
h. Spruce-pine-fir (south).

F. Finishes for Stair Parts:

1. Treads: Transparent, Opaque.
2. Risers: Transparent, Opaque.
3. Stringers: Transparent, Opaque.
4. Balusters: Transparent, Opaque.
5. Handrails: Transparent, Opaque.
6. Scotia, Cove, and Other Moldings: Transparent, Opaque.

G. Handrail Brackets: Cast nickel-silver, Cast aluminum, Cast bronze, Cast stainless steel with wall flange drilled for exposed anchor and tapped for concealed hanger bolt and with support arm for screwing to underside of rail. Size to provide 1-1/2-inch (38-mm) clearance between handrail and face of wall.

H. Handrail/Bumper Rail Brackets: Pairs of extruded-aluminum channels: one for fastening to back of rail and one for fastening to face of wall, assembled in overlapping fashion and fastened together at top and bottom with self-tapping screws. Size to provide 1-1/2-inch (38-mm) clearance between handrail and wall.

2.8 HARDWOOD SHEET MATERIALS

A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2, Grade M-2-Exterior Glue.
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.9 FIRE-RETARDANT-TREATED WOOD MATERIALS

A. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of the Architectural Woodwork Standards. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
4. Mill lumber before treatment, and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1, except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

2.10 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.

a. Provide where indicated, where in contact with concrete or masonry.
b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2. Fire-Retardant Treatment: Complying with requirements; provide where indicated.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.11 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Stairs: Cut rough carriages to accurately fit treads and risers.

1. Glue treads to risers, and glue and nail treads and risers to carriages.
2. House wall and face stringers, and glue and wedge treads and risers.

3. Fabricate stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position and no more than 1/16 inch (1.5 mm) out of relative position for adjacent treads and risers.

2.12 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099123 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.13 SHOP FINISHING

A. Finish interior architectural woodwork with transparent finish, indicated on Drawings at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium, Custom, Economy, Same as item to be finished.
2. Finish: System - 1, Lacquer, Nitrocellulose.
3. Finish: System - 2, Lacquer, Pre Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed.
5. Finish: System - 4, Latex Acrylic, Water Based.
6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 6, Oil, Synthetic Penetrating.
8. Finish: System - 7, Vinyl, Catalyzed.

9. Finish: System - 8, Acrylic Cross Linking, Water Based.
10. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
11. Finish: System - 10, UV Curable, Water Based.
12. Finish: System - 11, Polyurethane, Catalyzed.
13. Finish: System - 12, Polyurethane, Water Based.
14. Finish: System - 13, Polyester, Catalyzed.
15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
16. Staining: None required, Match approved sample for color, Match Architect's sample.
17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
18. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
19. Sheen: Flat, 15-30, Satin, 31-45, Semigloss, 46-60, Gloss, 61-100 gloss units measured on 60-degree gloss meter according to ASTM D523.

D. Opaque Finish:

1. Architectural Woodworking Standards Grade: Premium, Custom, Economy, Same as item to be finished.
2. Finish: System - 1, Lacquer, Nitrocellulose.
3. Finish: System - 2, Lacquer, Pre Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed.
5. Finish: System - 4, Latex Acrylic, Water Based.
6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 7, Vinyl, Catalyzed.
8. Finish: System - 8, Acrylic Cross Linking, Water Based.
9. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
10. Finish: System - 10, UV Curable, Water Based.
11. Finish: System - 11, Polyurethane, Catalyzed.
12. Finish: System - 12, Polyurethane, Water Based.
13. Finish: System - 13, Polyester, Catalyzed.
14. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.
15. Sheen: Flat, 15-30, Satin, 31-45, Semigloss, 46-60, Gloss, 61-100 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

H. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
2. Do not use pieces less than 36 inches (900 mm), 60 inches (1500 mm), 96 inches (2400 mm) long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished, latex sealant, painted to match wall.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

I. Stairs: Securely anchor carriages to supporting substrates.

1. Install stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position.
2. Secure with countersunk, concealed fasteners and blind nailing.
3. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

J. Railings:

1. Install rails with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.
2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.

    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

3. Wall Rails: Support rails on wall brackets securely fastened to wall framing.

    a. Space rail brackets not more than o.c.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program, WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064023

SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing architectural cabinets that are not concealed within other construction.
3. Shop finishing of architectural cabinets.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For architectural cabinets.

1. Include plans, elevations, sections, and attachment details.
2. As directed apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Research reports.

C. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: As directed AWI Quality Certification Program or WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: As directed Licensed participant in AWI's Quality Certification Program or Licensed participant in WI's Certified Compliance Program.

B. Installer Qualifications: As directed Manufacturer of products, Licensed participant in AWI's Quality Certification Program or Licensed participant in WI's Certified Compliance Program.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, as directed provide products by the following, provide products by one of the following or available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. As directed.

2.2 CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI or WI certification program as directed indicating that woodwork and installation complies with requirements of grades specified.

a. This project has been registered with AWI as AWI Quality Certification Program Number as directed.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

B. Type of Construction: As directed Frameless or Face frame.

C. Door and Drawer-Front Style: As directed Flush overlay, Reveal overlay, Lipped or Flush inset.

1. Reveal Dimension: 1/2 inch (13 mm) or As indicated on Drawings.

D. Wood for Exposed Surfaces: As indicated on Drawings.

1. Species: As directed Red oak, White oak, White ash or White birch.
2. Cut: As directed Plain sliced/plain sawn, Rift cut/rift sawn or Quarter cut/quarter sawn.
3. Grain Direction: As directed Vertically for drawer fronts, doors, and fixed panels, horizontally for drawer fronts, doors, and fixed panels, Vertically for doors and fixed panels, horizontally for drawer fronts or as indicated on Drawings.
4. Matching of Veneer Leaves: As directed Book, Slip or Random match.
5. Veneer Matching within Panel Face: As directed Running, Balance or Center-balance match.

E. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.4 WOOD CABINETS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

B. Type of Construction: As directed Frameless or Face frame.

C. Door and Drawer-Front Style: As directed Flush overlay, reveal overlay, Lipped or Flush inset.

1. Reveal Dimension: 1/2 inch (13 mm) or as indicated on Drawings.

D. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.

E. Panel Product for Exposed Surfaces: As directed MDF or Medium-density overlay.

F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.5 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (75 mm) wide.
2. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. MDF: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue as directed.
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
6. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.7 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" as directed

B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): As directed BHMA A156.9, B01602, 100, 135 or 170 degrees of opening, self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, plastic, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter or 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter as directed.

F. Catches: As directed Magnetic catches, BHMA A156.9, B03141, Push-in magnetic catches, BHMA A156.9, B03131 or Roller catches, BHMA A156.9, B03071 or Ball friction catches, BHMA A156.9, B03013 as directed.

G. Adjustable Shelf Standards and Supports: As directed BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112.

H. Shelf Rests: BHMA A156.9, B04013; As directed metal, plastic or two-pin plastic with shelf hold-down clip.

I. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

    a. Type: As directed Full or Partial extension.
    b. Material: As directed Zinc-plated or Epoxy-coated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: As directed Side mounted; full or full-overtravel-extension type; zinc-plated-steel, ball-bearing slides.
3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 2 or Grade 1 as directed.
4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1 or Grade 1HD-100 as directed.
5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100 or Grade 1HD-200.
6. For computer keyboard shelves, provide As directed Grade 1 or Grade 1HD-100.
7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100 or Grade 1HD-200 as directed.

J. Slides for Sliding Glass Doors: BHMA A156.9, B07063; plastic or aluminum.

K. Door Locks: BHMA A156.11, E07121.

L. Drawer Locks: BHMA A156.11, E07041.

M. Door and Drawer Silencers: BHMA A156.16, L03011.

N. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear) or Class 2 or 3 (tinted), Quality-Q3 as directed.

1. Thickness: As directed 3.0 mm, 4.0 mm, 5.0 mm or 6.0 mm.
2. Tint Color: As directed Blue-green, Bronze, Green or Gray.

O. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear) or Class 2 or 3 (tinted), Quality-Q3, 6 mm thick unless otherwise indicated.

1. Tint Color: As directed Blue-green, Bronze, Green or Gray.
2. Unframed Glass Doors: Seam exposed edges seamed before tempering.

P. Mirror Glass for Cabinet Doors: ASTM C1503, Mirror Select or Glazing, Quality-Q3 as directed.

1. Thickness: As directed 3.0 mm, 4.0 mm, 5.0 mm or 6.0 mm.

Q. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."

R. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear) or Class 2 or 3 (tinted), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick as directed.

1. Tint Color: As directed Blue-green, Bronze, Green or Gray.

S. Grommets for Cable Passage: As directed 1-1/4-inch (32-mm) or 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As directed Brown or Black.

T. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
7. Satin Stainless Steel: BHMA 630.

U. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: As directed Softwood or hardwood lumber or Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.9 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."

1. For glass in wood frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

2.10 SHOP FINISHING

A. General: Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop finish transparent-finished architectural cabinets at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of opaque-finished architectural cabinets.

C. General: Drawings indicate items that are required to be shop finished. Finish these items at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing of architectural cabinets.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

F. Transparent Finish:

1. Architectural Woodwork Standards Grade: As directed Premium, Custom, Economy or Same as item to be finished.

2. Finish: System – As directed 1, nitrocellulose lacquer, 2, precatalyzed lacquer, 3, postcatalyzed lacquer, 4, water-based latex acrylic, 5, conversion varnish, 6, synthetic penetrating oil, 7, catalyzed vinyl, 8, water-based crosslinking acrylic, 9, UV-curable acrylated epoxy, polyester, or urethane, 10, water-based UV curable, 11, catalyzed polyurethane, 12, water-based polyurethane or 13, catalyzed polyester.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: As directed None required, Match approved sample for color or Match Architect's sample.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D523.

G. Opaque Finish:

1. Architectural Woodwork Standards Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System – As directed 1, nitrocellulose lacquer, 2, precatalyzed lacquer, 3, postcatalyzed lacquer, 4, water-based latex acrylic, 5, conversion varnish, 7, catalyzed vinyl, 8, water-based crosslinking acrylic, 9, UV-curable acrylated epoxy, polyester, or urethane, 10, water-based UV curable, 11, catalyzed polyurethane, 12, water-based polyurethane or 13, catalyzed polyester.
3. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.
4. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with cabinet surface.

1. For shop-finished items, use filler matching finish of items being installed.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm)using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish as directed.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

F. Field Finishing: See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for finishing of installed architectural cabinets.

3.2 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program or WI's Certified Compliance Program certifying that woodwork as directed, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064113

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals: As directed

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification, WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Research reports.

C. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program, WI Certified Compliance Program certificates.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program, Licensed participant in WI's Certified Compliance Program.

B. Installer Qualifications: Manufacturer of products, Licensed participant in AWI's Quality Certification Program, Licensed participant in WI's Certified Compliance Program.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI, WI certification program indicating that woodwork complies with requirements of grades specified.

a. This project has been registered with AWI as AWI Quality Certification Program Number.

B. Architectural Woodwork Standards Grade: Premium, Custom, Economy.

C. Type of Construction: Frameless, Face frame.

D. Door and Drawer-Front Style: Flush, Reveal, overlay.

1. Reveal Dimension: 1/2 inch (13 mm) and or as indicated.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS, Grade HGL.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS, Grade VGS.

4. Edges: Grade HGS, Grade VGS, PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish, PVC T-mold matching laminate in color, pattern, and finish, PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels, Horizontally for drawer fronts, doors, and fixed panels, Vertically for doors and fixed panels, horizontally for drawer fronts and or as indicated.

G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
2. Match Architect's sample.
3. As selected by Architect from laminate manufacturer's full range in the following categories:

a. Solid colors, gloss, matte finish.
b. Solid colors with core same color as surface, gloss, matte, finish.
c. Wood grains, gloss, matte, finish.
d. Patterns, gloss, matte, finish.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10, 8 to 13, 4 to 9 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2, Grade M-2-Exterior Glue.
3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100, 135, 170, degrees of opening, self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, plastic, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.

F. Catches: Magnetic catches, BHMA A156.9, B03141, Push-in magnetic catches, BHMA A156.9, B03131, Roller catches, BHMA A156.9, B03071, Ball friction catches, BHMA A156.9, B03013.

G. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081, BHMA A156.9, B04102; with shelf brackets, B04112.

H. Shelf Rests: BHMA A156.9, B04013; metal, plastic, two-pin plastic with shelf hold-down clip.

I. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

a. Type: Full, Partial extension.
b. Material: Zinc-plated, Epoxy-coated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full, full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 2, Grade 1.
4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1, Grade 1HD-100.
5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100, Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1, Grade 1HD-100.
7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100, Grade 1HD-200.

J. Slides for Sliding Glass Doors: BHMA A156.9, B07063; plastic, aluminum.

K. Door Locks: BHMA A156.11, E07121.

L. Drawer Locks: BHMA A156.11, E07041.

M. Door and Drawer Silencers: BHMA A156.16, L03011.

N. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Class 2 or 3 (tinted), Quality-Q3.

1. Thickness: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm.
2. Tint Color: Blue-green, Bronze, Green, Gray.

O. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Class 2 or 3 (tinted), Quality-Q3, 6 mm thick unless otherwise indicated.

1. Tint Color: Blue-green, Bronze, Green, Gray.
2. Unframed Glass Doors: Seam exposed edges seamed before tempering.

P. Mirror Glass for Cabinet Doors: ASTM C1503, Mirror Select, Glazing, Quality-Q3.

1. Thickness: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm.

Q. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."

R. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Class 2 or 3 (tinted), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

1. Tint Color: Blue-green, Bronze, Green, Gray.

S. Grommets for Cable Passage: 1-1/4-inch (32-mm), 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Brown, Black.

T. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
7. Satin Stainless Steel: BHMA 630.

U. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement, Contact cement, PVA, Urea formaldehyde, Resorcinol.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."

1. For glass in frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish toggle bolts through metal backing or metal framing behind wall finish.

3.2 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program, WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064116

SECTION 064214 - STILE AND RAIL WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stile and rail wood paneling.
2. Wood furring, blocking, shims, and hanging strips for installing stile and rail wood paneling that are not concealed within other construction.
3. Shop finishing of stile and rail wood paneling.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. As Directed

C. Shop Drawings: For stile and rail wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings as directed.

D. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: As directed AWI Quality Certification Program or WI Certified Compliance Program.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: As directed AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee.

B. Installer Qualifications: As directed Fabricator of products, AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling and wood-veneer-faced architectural cabinets, ornamental woodwork, wood trim, wood frames and wood doors faced with veneers from same flitches as paneling as directed.

B. Fabricators: Subject to compliance with requirements, provide products by the following, provide products by one of the following or available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following as directed:

1. As directed.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of stile and rail wood paneling (stile and rail wall surfacing) indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI or WI certification program as directed indicating that woodwork complies with requirements of grades specified.

2.3 STILE AND RAIL WOOD PANELING FOR TRANSPARENT FINISH

A. Grade: As directed Premium, Custom or Economy.

B. Wood Species: As directed White oak, rift sawn/sliced, Figured English ash, quarter sawn/sliced, Butternut, plain sawn/sliced or Figured red gum, plain-sawn/sliced panels, quarter-sawn/sliced stiles and rails.

C. Stiles and Rails: At fabricator's option, stiles and rails may be either lumber or veneered construction with edges banded or with lumber moldings, as indicated, to conceal core and veneer joints.

D. Panels: As directed Flat panels, Raised panels with veneered faces and solid-lumber rims, Raised panels with veneered faces extending across rims or Raised panels made from edge-glued solid lumber.

E. Insert Panels: Book and balance match face veneers within panels. No matching is required between adjacent panels; select and arrange panels for similarity of grain pattern and color between adjacent panels.

F. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop if site conditions permit.

2.4 STILE AND RAIL WOOD PANELING FOR OPAQUE FINISH

A. Grade: As directed Premium, Custom or Economy.

B. Wood Species: As directed Any closed-grain hardwood or Eastern white pine, ponderosa pine, sugar pine, or western white pine.

C. Stiles and Rails: Either solid lumber or particleboard, shop filled on face, with veneered or lumber-banded edges, at paneling fabricator's option.

D. Flat Insert Panels: MDF or particleboard with shop-filled face.

E. Raised Insert Panels: As directed Medium-density overlaid softwood plywood (exterior), machined to profile indicated and shop filled on exposed machined surfaces or MDF, machined to profile indicated.

F. Provide fire-retardant treatment of stile and rail paneling as indicated below. For components of paneling fabricated from solid lumber, mill pieces before treatment.

1. Stiles and Rails: As directed Fire-retardant-treated lumber, fire-retardant MDF or fire-retardant particleboard with fire-retardant-lumber edge bands.
2. Insert Panels: Fire-retardant MDF or fire-retardant particleboard with closed-grain hardwood veneer on face and back.

G. Shop assemble stile and rail paneling into largest units practical for delivery and installation. Provide shop-prepared detachable joints for necessary field connections. Sand and pull joints tight in shop so field joints will comply with joint tolerances for specified grade. Unless otherwise indicated, provide continuous mortise-and-tenon joints between panel units and provide removable temporary protection for joints during handling and delivery.

1. Outside Corner of Stile and Rail Paneling: Shop prepare using lock-mitered or mitered-and-splined construction. Assemble, sand, and glue in shop if site conditions permit.

2.5 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
1. MDF: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, As directed Grade M-2 or Grade M-2-Exterior Glue.
3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.7 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: As directed Softwood or hardwood lumber or Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.8 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items.

2.9 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop finish transparent-finished paneling at fabrication shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of opaque-finished paneling.

C. General: Drawings indicate paneling that is required to be shop finished. Finish shop-finished paneling at fabrication shop as specified in this Section. Refer to Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing paneling not indicated to be shop finished.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished paneling specified to be field finished.

1. See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

F. Transparent Finish:

1. Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System – As directed 1, nitrocellulose lacquer, 2, precatalyzed lacquer, 3, postcatalyzed lacquer, 4, water-based latex acrylic, 5, conversion varnish, 6, synthetic

penetrating oil, 7, catalyzed vinyl, 8, water-based cross linking acrylic, 9, UV curable acrylated epoxy, polyester, or urethane, 10, water-based UV curable, 11, catalyzed polyurethane, 12, water-based polyurethane or 13, catalyzed polyester.

3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: As directed None required, Match approved sample for color or Match Architect's sample.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D523.

G. Opaque Finish:

1. Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System – As directed 1, nitrocellulose lacquer, 2, precatalyzed lacquer, 3, postcatalyzed lacquer, 4, water-based latex acrylic, 5, conversion varnish, 7, catalyzed vinyl, 8, water-based cross linking acrylic, 9, UV curable acrylated epoxy, polyester, or urethane, 10, water-based UV curable, 11, catalyzed polyurethane, 12, water-based polyurethane or 13, catalyzed polyester.
3. Colors: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.
4. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

C. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

D. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor paneling to supporting substrate with concealed panel-hanger clips, splined connection strips or blind nailing as directed.

1. Do not use face fastening unless covered by trim or otherwise indicated.

F. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

G. See Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

END OF SECTION 064214

SECTION 064216 - FLUSH WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush wood paneling.
2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling that is not concealed within other construction.
3. Shop finishing of flush wood paneling.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. As directed.

C. Shop Drawings: For flush wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings as directed.

D. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: As directed AWI Quality Certification Program or WI Certified Compliance Program.

B. Research reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: As directed AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee.

B. Installer Qualifications: As directed Fabricator of products, AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee as directed.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling and wood-veneer-faced architectural cabinets, ornamental woodwork, wood trim, wood frames and wood doors faced with veneers from same flitches as paneling as directed.

B. Fabricators: Subject to compliance with requirements, provide products by the following, provide products by one of the following or available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:

1. As directed.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI or WI certification program as directed indicating that woodwork complies with requirements of grades specified.

2.3 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

A. Grade: As directed Premium, Custom or Economy.

B. Wood Species and Cut: As directed White oak, rift sliced, Select white ash, plain sliced, Sycamore, plain sliced, Cherry, plain sliced, Butternut, plain sliced or Avodire, quarter sliced.

C. Veneer Matching Method:

1. Adjacent Veneer Leaves: As directed Book, Slip or Pleasing (Random) match.
2. Within Panel Face: As directed Running, Balance or Center-balance match.

3. Adjacent Veneer Leaves and within Panel Face: Slip, center-balance, or book match.

D. Panel-Matching Method:

1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
2. As directed Premanufactured panel sets used full width, Premanufactured panel sets selectively reduced in width or Made-to-order, sequence-matched panels within each separate area.

E. Panel Core Construction: As directed Hardwood veneer-core plywood, Particleboard or MDF, Fire-retardant particleboard or fire-retardant MDF.

1. Thickness: As directed 3/4 inch (19 mm) or as indicated on Drawings.

F. Exposed Panel Edges: As directed Inset solid-wood or wood-veneer matching faces, Legs of metal channels forming reveals, applied solid-wood banding 11/16 inch (18 mm) thick by depth of panels or Applied bronze flat bars 1/16 inch (1.6 mm) thick by depth of panels.

G. Panel Reveals: As directed Matte black plastic laminate, Bronze sheet, Stainless-steel sheet, Bronze channels, 1 by 1 by 1/8 inch (25.4 by 25.4 by 3.2 mm) thick or Stainless-steel channels, 1 by 1 by 1/16 inch (25.4 by 25.4 by 1.6 mm) thick.

H. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels shall have a flame-spread index of 25 or 75 or less as directed and a smoke-developed index of 450 or less per ASTM E84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

I. Assemble panels by gluing and concealed fastening.

2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.
1. MDF: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue as directed.
3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.6 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: As directed Softwood or hardwood lumber or Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site.

C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items.

2.8 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished paneling specified to be field finished. See Section 099300 "Staining and Transparent Finishing" for material and application requirements.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

D. Transparent Finish:

1. Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System – As directed 1, nitrocellulose lacquer, 2, precatalyzed lacquer, 3, postcatalyzed lacquer, 4, water-based latex acrylic, 5, conversion varnish, 6, synthetic penetrating oil, 7, catalyzed vinyl, 8, water-based cross linking acrylic, 9, UV curable acrylated epoxy, polyester, or urethane, 10, water-based UV curable, 11, catalyzed polyurethane, 12, water-based polyurethane or 13, catalyzed polyester.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: As directed None required, Match approved sample for color or Match Architect's sample.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

C. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch (0.8 mm) or 1/16 inch (1.5 mm) as directed.

D. Anchor paneling to supporting substrate with concealed panel-hanger clips, splined connection strips or blind nailing as directed.

1. Do not use face fastening unless covered by trim or otherwise indicated.

E. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

F. See Section 099300 "Staining and Transparent Finishing" for final finishing of installed paneling.

END OF SECTION 064216

SECTION 064219 - PLASTIC-LAMINATE-FACED WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced wood paneling.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced wood paneling that is not concealed within other construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. As directed

C. Shop Drawings: For plastic-laminate-faced wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. As directed Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Quality Standard Compliance Certificates: As directed AWI Quality Certification Program or WI Certified Compliance Program.

C. Research reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: As directed AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee.

B. Installer Qualifications: As directed Fabricator of products, AWI's Quality Certification Program accredited participant or WI's Certified Compliance Program licensee.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide products by the following, provide products by one of the following or available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:

1. As directed.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-faced wood paneling (decorative laminate surfacing) indicated for construction, finishes, installation, and other requirements.

1. As directed Provide inspections including installation together with labels and certificates from AWI or WI certification program indicating that woodwork complies with requirements of grades specified.

2.3 PLASTIC-LAMINATE-FACED WOOD PANELING

A. Grade: As directed Premium, Custom or Economy.

B. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3 and the following requirements:
1. Faces: As directed Grade SGF, Grade HGS, Grade HGF, Grade VGS or Grade VGF.
2. Backs: As directed Grade BKH, Grade BKV, Grade VGF or Grade BKL.
3. Exposed Edges: Same as faces or Grade VGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed surfaces complying with the following requirements:

1. As indicated by manufacturer's designations.
2. Match Architect's samples.

3. As selected by Architect from laminate manufacturer's full range in the following categories:

    a. Solid colors, As directed gloss or matte finish.
    b. Solid colors with core same color as surface, gloss or matte finish as directed.
    c. Wood grains, gloss or matte finish as directed.
    d. Patterns, gloss or matte finish as directed.

4. Grain Direction: As directed Vertical or Horizontal.

D. Panel Core: As directed Particleboard or MDF or Fire-retardant particleboard or fire-retardant MDF.

1. Thickness: 3/4 inch (19 mm) or As indicated on Drawings.

E. Exposed Panel Edges: As directed Plastic-laminate matching faces, Legs of metal channels forming reveals, applied solid-wood banding 11/16 inch (18 mm) thick by depth of panels or applied bronze flat bars 1/16 inch (1.6 mm) thick by depth of panels.

F. Panel Reveals: As directed Matte black plastic laminate, Bronze sheet, Stainless-steel sheet or Bronze channels, 1 by 1 by 1/8 inch (25.4 by 25.4 by 3.2 mm) thick or Stainless-steel channels, 1 by 1 by 1/16 inch (25.4 by 25.4 by 1.6 mm) thick.

G. Adhesives for Bonding Plastic Laminate: As directed Unpigmented contact cement, Contact cement, PVA, Urea formaldehyde or Resorcinol.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

H. Fire-Retardant-Treated Paneling: Panels shall consist of fire-retardant plastic laminate and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels shall have a flame-spread index of 25 or 75 or less as directed and a smoke-developed index of 450 or less per ASTM E84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

I. Assemble panels by gluing and concealed fastening.

2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

D. As directed.

1. MDF: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.6 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: As directed Softwood or hardwood lumber or Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.7 FABRICATION

A. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site.

B. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

C. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch (0.8 mm) or 1/16 inch (1.5 mm) as directed.

D. As directed Anchor paneling to supporting substrate with concealed panel-hanger clips, splined connection strips or blind nailing. Do not use face fastening unless covered by trim or otherwise indicated.

END OF SECTION 064219

SECTION 064400 - ORNAMENTAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior ornamental woodwork.
2. Interior ornamental woodwork.
3. Wood furring, blocking, shims, and hanging strips for installing ornamental woodwork items that are not concealed within other construction.
4. Shop priming of exterior ornamental woodwork.
5. Shop priming of interior ornamental woodwork.
6. Shop finishing of exterior ornamental woodwork.
7. Shop finishing of interior ornamental woodwork.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Composite wood and agrifiber products.
2. Fire-retardant-treated materials.
3. Finishing materials and processes.
4. Wood-Preservative Treatment:

    a. Include data and warranty from chemical-treatment manufacturer and certification by treating plant that treated materials to comply with requirements.
    b. Indicate type of preservative used and net amount of preservative retained.
    c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.

5. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials to comply with requirements.
6. Waterborne Treatments: For products receiving a waterborne treatment, Include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. As directed.

C. Shop Drawings: Show location of each item, including the following:

1. Dimensioned plans, elevations, and sections.
2. Attachment devices, and other components.
3. Show large-scale or full-size details as directed.
4. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
6. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings as directed.

D. Samples: For each exposed product and for each shop-applied color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For ornamental woodwork manufacturer and Installer.

B. Product Certificates: For each type of product the following:

1. Composite wood and agrifiber products.
2. Adhesives.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: As directed AWI Quality Certification Program or WI Certified Compliance Program certificates as directed.

1.6 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program or WI's Certified Compliance Program as directed.

B. Installer Qualifications: Manufacturer of products and, Licensed participant in AWI's Quality Certification Program or Licensed participant in WI's Certified Compliance Program as directed.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups as directed.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.7 FIELD CONDITIONS

A. Weather Limitations for Exterior Work: Proceed with installation of exterior ornamental woodwork only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish is to be applied without exposure to rain, snow, or dampness.

B. Environmental Limitations for Interior Work: Do not deliver or install interior ornamental woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupancy for the remainder of the construction period.

C. Environmental Limitations for Interior Work: Do not deliver or install interior ornamental woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55, 43 and 70 or 17 and 50 percent during the remainder of the construction period as directed.

PART 2 - PRODUCTS

2.1 ORNAMENTAL WOODWORK MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following or available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. As directed.

2.2 ORNAMENTAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of ornamental woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI or WI certification program as directed indicating that woodwork, including installation, complies with requirements of grades specified.

a. This project has been registered with AWI as AWI Quality Certification Program Number as directed.
b. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 800-345-0991.

2.3 EXTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Exterior ornamental work for transparent finish includes the following:

1. Balustrades.

2. Columns.
3. Cupolas.
4. Pediment heads.
5. Pilasters.

B. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

C. Wood Species: As directed Teak, African mahogany, All-heart redwood, Western red cedar or Ponderosa pine or sugar pine.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

D. Wood Moisture Content: As directed 9 to 15, 10 to 15 or 7 to 12 percent.

2.4 EXTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

A. Exterior ornamental work for opaque finish includes the following:

1. Balustrades.
2. Columns.
3. Cupolas.
4. Pediment heads.
5. Pilasters.

B. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

C. Wood Species: As directed All-heart redwood, Western red cedar, Ponderosa pine, Ponderosa pine or sugar pine, Eastern white pine, sugar pine, or western white pine, Any closed-grain hardwood or Softwood plywood.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (76 mm) wide.

D. Wood Moisture Content: As directed 9 to 15, 10 to 15 or 7 to 12 percent.

2.5 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Interior ornamental work for transparent finish includes the following:

1. Altar.
2. Balustrades.
3. Columns.
4. Grilles.
5. Judge's bench.
6. Lectern.
7. Mantels.
8. Pediment heads.
9. Pilasters.
10. Pulpit.

11. Witness stand.

B. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

C. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished ornamental woodwork located in same area of building unless otherwise indicated.

1. Species: As directed Red oak, White oak, White ash or Hickory.
2. Cut: As directed Plain sliced/plain sawn, Rift cut/rift sawn, Quarter cut/quarter sawn or Any cut.

D. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

2.6 INTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

A. Interior ornamental work for opaque finish includes the following:

1. Altar.
2. Balustrades.
3. Columns.
4. Grilles.
5. Lectern.
6. Mantels.
7. Pediment heads.
8. Pilasters.
9. Pulpit.

B. Architectural Woodwork Standards Grade: As directed Premium, Custom or Economy.

C. Wood Species: As directed Any closed-grain hardwood or Eastern white pine, sugar pine, or western white pine.

D. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.

2.7 WOOD MATERIALS

A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of ornamental woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue as directed.
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
4. Softwood Plywood: DOC PS 1, exterior , medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.8 PRESERVATIVE-TREATED WOOD MATERIALS

A. Preservative-Treated Wood Materials: Provide with water-repellent preservative treatment complying with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment).

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with a compatible EPA registered insecticide.
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

B. Extent of Preservative Treated Wood Materials: As directed Treat exterior ornamental woodwork indicated on Drawings, exterior ornamental woodwork unless otherwise indicated on Drawings or interior ornamental woodwork in contact with concrete or masonry.

1. Items fabricated from the following wood species need not be treated:

a. As directed Redwood or All-heart redwood.
b. As directed Western red cedar or All-heart western red cedar.
c. White oak.
d. African mahogany.
e. Honduras mahogany.
f. Ipe.
g. Dark red meranti.
h. Teak.

2.9 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of Architectural Woodwork Standards for the grade specified. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. For exterior applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D2898.

2. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
3. For items indicated to receive a stained, transparent or natural finish, use organic resin chemical formulation.
4. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
5. Mill lumber before treatment, and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1, except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

2.10 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329/F2329M unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless steel fasteners.
3. For redwood, use brass/bronze, stainless steel or hot-dip galvanized-steel fasteners as directed.

B. Nails: ASTM F1667.

C. Power-Driven Fasteners: ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 (ASTM F836M, Grade A1 or Grade A4) hex nuts and, where indicated, flat washers.

G. Postinstalled Anchors: Stainless steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or Grade A4).

2.11 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, Hanging Strips, and Nailers: Softwood or hardwood lumber, pressure-preservative treated, fire-retardant treated, kiln dried to less than 15 percent moisture content.

1. Wood-Preservative Treatment: By pressure process, AWPA U1; Use Category UC3b.

a. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

2. Fire-Retardant Treatment: Complying with requirements; provide where indicated on Drawings.

B. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.12 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate ornamental woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

C. Complete fabrication, including assembly and finishing, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
3. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.13 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing ornamental woodwork, as applicable to each unit of work.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of ornamental woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Exterior Ornamental Woodwork for Opaque Finish: Shop prime all surfaces with one coat of wood primer specified in Section 099113 "Exterior Painting."

D. Exterior Ornamental Woodwork for Transparent Finish:

1. Shop seal surfaces to be concealed.
2. Shop seal exposed surfaces with stain (if specified), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

E. Interior Ornamental Woodwork for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

F. Interior Ornamental Woodwork for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.14 SHOP FINISHING

A. Finish ornamental woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Shop finish transparent-finished ornamental woodwork at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for field finishing opaque-finished ornamental woodwork.

C. Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting", Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing ornamental woodwork not indicated to be shop finished.

D. Transparent Finish for Exterior Items: Comply with Section 099300 "Staining and Transparent Finishing."

E. Opaque Finish for Exterior Items: Comply with Section 099113 "Exterior Painting."

F. Transparent Finish for Interior Items:

1. Architectural Woodwork Standards Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System - 1, Lacquer, Nitrocellulose.
3. Finish: System - 2, Lacquer, Pre-Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed.
5. Finish: System - 4, Latex Acrylic, Water-Based.
6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 6, Oil, Synthetic Penetrating.
8. Finish: System - 7, Vinyl, Catalyzed.
9. Finish: System - 8, Acrylic Cross Linking, Water-Based.
10. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
11. Finish: System - 10, UV curable, Water-Based.
12. Finish: System - 11, Polyurethane, Catalyzed.
13. Finish: System - 12, Polyurethane, Water-Based.
14. Finish: System - 13, Polyester, Catalyzed.
15. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
16. Staining: As directed None required, Match approved sample for color or Match Architect's sample.
17. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
18. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
19. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter according to ASTM D523.

G. Opaque Finish for Interior Items:

1. Architectural Woodwork Standards Grade: As directed Premium, Custom, Economy or Same as item to be finished.
2. Finish: System - 1, Lacquer, Nitrocellulose.

3. Finish: System - 2, Lacquer, Pre-Catalyzed.
4. Finish: System - 3, Lacquer, Post Catalyzed Lacquer.
5. Finish: System - 4, Latex Acrylic, Water-Based.
6. Finish: System - 5, Varnish, Conversion.
7. Finish: System - 7, Vinyl, Catalyzed.
8. Finish: System - 8, Acrylic Cross Linking, Water-Based.
9. Finish: System - 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
10. Finish: System - 10, UV Curable, Water-Based.
11. Finish: System - 11, Polyurethane, Catalyzed.
12. Finish: System - 12, Polyurethane, Water-Based.
13. Finish: System - 13, Polyester, Catalyzed.
14. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.
15. Sheen: As directed Flat, 15-30, Satin, 31-45, Semigloss, 46-60 or Gloss, 61-100 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition ornamental woodwork to average prevailing humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing ornamental woodwork, examine shop-fabricated work for completion, and complete work as required, including removing packing and backpriming concealed surfaces.

3.2 INSTALLATION

A. Grade: Install ornamental woodwork to comply with same grade as item to be installed.

B. Assemble ornamental woodwork, and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install ornamental woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut ornamental woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Preservative-Treated Wood: Where cut or drilled, treat cut ends and drilled holes according to AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor ornamental woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with ornamental woodwork.
3. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.
4. For shop-finished items, use filler matching finish of items being installed.

3.3 FIELD QUALITY CONTROL

A. Inspections: As directed Provide inspection of installed Work through AWI's Quality Certification Program or WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION 064400

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Samples: For plastic paneling and trim accessories.

1.3 QUALITY ASSURANCE

A. Testing Agency: As directed Acceptable to authorities having jurisdiction or FM Approvals.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels shall be USDA accepted for incidental food contact.

1. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: As directed 25 or 200 or less.
    b. Smoke-Developed Index: 450 or less.

2. Nominal Thickness: As directed Not less than 0.075 inch (1.9 mm), 0.09 inch (2.3 mm) or 0.12 inch (3.0 mm).
3. Surface Finish: As directed Smooth, Molded pebble texture, Smooth surface with filled grooves at 4 inches (102 mm) o.c. to resemble tile, as indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.
4. Color: As directed White, as indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: As directed White, Match panels, as indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

B. Sealant: As directed Mildew-resistant, single-component, neutral-curing silicone, Mildew-resistant, single-component, neutral-curing or acid-curing silicone or Latex sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints where indicated to provide equal panels at ends of walls not less than half the width of full panels so that trimmed panels at corners are not less than 12 inches (300 mm) wide.

3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 067413 - FIBERGLASS REINFORCED GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glass-fiber-reinforced-plastic gratings and frames and supports for gratings.

1.2 ACTION SUBMITTALS

A. Product Data: For glass-fiber-reinforced-plastic gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For gratings, including manufacturer's published load tables, analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Floors: Uniform load of 125 lbf/sq. ft. (6.00 kN/sq. m) or concentrated load of 2000 lbf (8.90 kN), whichever produces the greater stress.
2. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 3000 lbf (13.40 kN), whichever produces the greater stress.
3. Walkways and Elevated Platforms: Uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m).
4. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.
5. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.3 GLASS-FIBER-REINFORCED-PLASTIC GRATINGS

A. Molded Glass-Fiber-Reinforced Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.

1. Configuration: 1-1/2-inch- (38-mm-) square mesh, 1 inch (25 mm) thick, 1-1/2-inch- (38-mm-) square mesh, 1-1/4 inches (32 mm) thick, 1-1/2-inch- (38-mm-) square mesh, 1-1/2 inches (38 mm) thick, 2-inch- (51-mm-) square mesh, 2 inches (51 mm) thick, 1-1/2-inch- (38-mm-) square mesh, thickness as required to comply with structural performance requirements or As required to comply with structural performance requirements.
2. Weight: As directed 2.5 lb/sq. ft. (12.2 kg/sq. m), 2.7 lb/sq. ft. (13.2 kg/sq. m), 3.2 lb/sq. ft. (15.6 kg/sq. m), 3.5 lb/sq. ft. (17.1 kg/sq. m), 3.7 lb/sq. ft. (18.1 kg/sq. m), 4.1 lb/sq. ft. (20.0 kg/sq. m) or 5.0 lb/sq. ft. (24.4 kg/sq. m).
3. Traffic Surface: As directed Plain, meniscus, applied abrasive finish or as indicated.

B. Pultruded Glass-Fiber-Reinforced Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.

1. Configuration: I4010; 1-inch (25-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open), I6010; 1-inch (25-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open), I4015; 1-1/2-inch (38-mm) I-bars spaced 1 inch (25 mm) o.c. (40 percent open), I6015; 1-1/2-inch (38-mm) I-bars spaced 1-1/2 inches (38 mm) o.c. (60 percent open), T3320; 2-inch (51-mm) T-bars spaced 1-1/2 inches (38 mm) o.c. (33 percent open), T5020; 2-inch (51-mm) T-bars spaced 2 inches (51 mm) o.c. (50 percent open) or as required to comply with structural performance requirements.
2. Weight: As directed 2.35 lb/sq. ft. (11.5 kg/sq. m), 2.83 lb/sq. ft. (13.8 kg/sq. m), 3.10 lb/sq. ft. (15.1 kg/sq. m), 3.41 lb/sq. ft. (16.6 kg/sq. m), 4.10 lb/sq. ft. (20.0 kg/sq. m) or 4.13 lb/sq. ft. (20.2 kg/sq. m).
3. Traffic Surface: Plain, grooved, applied abrasive finish or as indicated.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 or Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.5 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form gratings from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.6 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Glass-Fiber-Reinforced-Plastic Gratings: Fabricate from glass-fiber-reinforced-plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Equip units indicated to be cast into concrete or built into masonry with integral anchors.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

B. Fit exposed connections accurately together to form hairline joints.

3.2 INSTALLING GLASS-FIBER-REINFORCED-PLASTIC GRATINGS

A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

END OF SECTION 067413

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Full tear-off of entire roof system of roof system at areas indicated on Drawings.
2. Partial tear-off of entire roof area or of roof areas indicated on Drawings.
3. Re-cover preparation of entire roof area of roof areas indicated on Drawings.
4. Removal of flashings and counter flashings.

1.2 ALLOWANCES

A. Allowance for removal of existing wet insulation, and replacement with new insulation, is specified under Section 012100 "Allowances."

B. Allowance for removal of existing deteriorated metal roof deck, and replacement with new metal roof deck, is specified under Section 012100 "Allowances."

C. Allowance for removal of existing deteriorated wood roof deck, and replacement with new wood deck, is specified under Section 012100 "Allowances."

D. Allowance for removal of existing deteriorated wood nailers and curbs, and replacement with new wood, is specified under Section 012100 "Allowances."

E. Allowance for removal of existing deteriorated parapet wall sheathing, and replacement with new sheathing, is specified under Section 012100 "Allowances."

1.3 UNIT PRICES

A. Work of this Section is affected by insulation removal and replacement unit price metal deck removal and replacement unit price roof sheathing removal and replacement unit price and parapet wall sheathing removal and replacement unit price.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.

1. Submit before Work begins.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.

1.7 FIELD CONDITIONS

A. Existing Roofing System: Built-up asphalt, Built-up coal-tar, APP-modified bituminous, SBS-modified bituminous, EPDM, CSPE, KEE, PVC, TPO, APP-modified bituminous protected membrane, SBS-modified bituminous protected membrane, Fluid-applied protected membrane Coated foamed roofing.

B. Owner will, will not occupy portions of building immediately below reroofing area.

1. Conduct reroofing so Owner's operations are not disrupted.
2. Provide Owner with not less than 72 hours' written notice of activities that may affect Owner's operations.
3. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
4. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area.

    a. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

E. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

1. A roof moisture survey of existing roofing system is available for Contractor's reference.
2. The results of an analysis of test cores from existing roofing system are available for Contractor's reference.
3. Construction Drawings and Project Manual for existing roofing system are provided for Contractor's convenience and information, but they are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own

investigations. Contractor is responsible for conclusions derived from existing documents.

F. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed to, for rooftop equipment wheel loads and for uniformly distributed loads

G. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty issued by manufacturer for existing warranted roof system.

PART 2 - PRODUCTS

2.1 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

B. Shut off rooftop utilities and service piping before beginning the Work.

C. Test existing roof drains to verify that they are not blocked or restricted.

1. Immediately notify Architect of any blockages or restrictions.

D. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.

1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.

1. Prevent debris from entering or blocking roof drains and conductors.

a. Use roof-drain plugs specifically designed for this purpose.
b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Remove aggregate ballast from roofing. Store aggregate ballast for reuse in manner not to exceed structural loading limitations of roof deck.

D. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing using a power broom.

E. Remove pavers and accessories from roofing.

1. Store and protect pavers and accessories for reuse in manner not to exceed structural loading limitations of roof deck.
2. Discard cracked pavers.

F. Full Roof Tear-off: Where indicated on Drawings, remove, Remove existing roofing and other roofing system components down to the existing roof deck, concrete fill.

1. Remove substrate board, vapor retarder, roof insulation and cover board.
2. Remove base flashings and counter flashings.
3. Remove perimeter edge flashing and gravel stops.
4. Remove copings.
5. Remove expansion-joint covers.
6. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
7. Remove roof drains indicated on Drawings to be removed.
8. Remove wood blocking, curbs, and nailers.
9. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.

a. Remove unadhered bitumen, unadhered felts, and wet felts.

10. Remove excess asphalt from steel deck.

    a. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.

11. Remove fasteners from deck or cut fasteners off slightly above deck surface.

G. Partial Roof Tear-off: Where indicated on Drawings, remove, Remove existing roofing down to existing cover board, existing insulation and immediately check for presence of moisture.

1. Engage, Owner will engage a qualified testing agency to perform the following test:

    a. Coordinate with Owner's testing agency to schedule times for tests and inspections immediately after removal.

2. Survey exposed substrate that is to remain using infrared color thermography according to ASTM C1153.

    a. Prepare survey report of initial scan indicating locations of entrapped moisture, if any, and area calculations of locations of entrapped moisture.

3. Survey exposed substrate that is to remain using electrical capacitance/impedance testing according to ASTM D7954/D7954M.

    a. Prepare survey report indicating locations of entrapped moisture, if any, and area calculations of locations of entrapped moisture.

4. Survey exposed substrate that is to remain using nuclear hydrogen detection testing according to SPRI/RCI NT-1.

    a. Prepare survey report indicating locations of entrapped moisture, if any, and area calculations of locations of entrapped moisture.

5. Remove wet or damp materials below existing roofing and above deck as directed by Architect.

    a. Removal is paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

6. Inspect wood blocking, curbs, and nailers for deterioration and damage.

    a. If wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.
    b. Removal is paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

7. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.

    a. Remove unadhered bitumen, unadhered felts, and wet felts.

8. Remove excess asphalt from steel deck that is exposed by removal of wet or damp materials.

    a. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.

9. Remove fasteners from deck or cut fasteners off slightly above deck surface.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

D. Provide additional deck securement as indicated on Drawings.

E. Replace steel deck as indicated on Drawings.

F. Replace steel deck as directed by Architect.

1. Deck replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

G. Prepare and paint steel deck surface.

1. Painting and preparation for painting is specified in Section 099113 "Exterior Painting."

H. Replace plywood roof sheathing as indicated on Drawings.

I. Replace plywood roof sheathing as directed by Architect.

1. Roof sheathing replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.4 ROOF RE-COVER PREPARATION

A. Remove blisters, ridges, buckles, mechanically attached roofing fastener buttons projecting above roofing, and other substrate irregularities from existing roofing that inhibit new recover boards from conforming to substrate.

1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.

2. Broom clean existing substrate.
3. Coordinate with Owner's inspector to schedule times for tests and inspections.
4. Verify that existing substrate is dry.

    a. Spot check substrates with an electrical capacitance moisture-detection meter.

5. Remove materials that are wet or damp.

    a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

B. Remove blisters, ridges, buckles, mechanically attached roofing fastener buttons projecting above roofing, and other substrate irregularities from existing roofing that inhibit new recover boards, roofing, from conforming to substrate.

1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.
2. Broom clean existing substrate.
3. Coordinate with Owner's inspector to schedule times for tests and inspections.
4. Verify that existing substrate is dry before proceeding with installation.

    a. Spot check substrates with an electrical capacitance moisture-detection meter.

5. Remove materials that are wet and damp.

    a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.5 BASE FLASHING REMOVAL

A. Remove existing base flashings.

1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counter flashings that are to remain.

1. Replace metal counter flashings damaged during removal with counter flashings of same metal, weight or thickness, and finish as existing. Specified in Section 076200 "Sheet Metal Flashing and Trim." Specified in Section 077100 "Roof Specialties."

C. Inspect parapet sheathing, wood blocking, curbs, and nailers for deterioration and damage.

1. If parapet sheathing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

D. Remove existing parapet sheathing and replace with new parapet sheathing to comply with Section 061600 "Sheathing."

1. If parapet framing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

E. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 054000 "Cold-Formed Metal Framing." Section 061000 "Rough Carpentry." Section 061053 Miscellaneous Rough Carpentry."

END OF SECTION 070150.19

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, cut-back-asphalt dampproofing.
2. Cold-applied, emulsified-asphalt dampproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.2 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Trowel Coats: ASTM D4586/D4586M, Type I, Class 1, fibered.

B. Brush and Spray Coats: ASTM D4479/D4479M, Type I, fibered or non-fibered.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Trowel Coats: ASTM D1227, Type II, Class 1.

B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.

C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D41/D41M.

C. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

D. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

E. Protection Course: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch (3 mm), 1/4 inch (6 mm).

F. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side or both sides with plastic film, nominal thickness 1/4 inch (6 mm), with a compressive strength of not less than 8 psi (55 kPa) per ASTM D1621, and maximum water absorption by volume of 0.6 percent per ASTM C272/C272M.

G. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C578, Type X, 1/2 inch (13 mm) thick.

H. Protection Course: Smooth-surfaced roll roofing complying with ASTM D6380/D6380M, Class S, Type III.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior, concrete and masonry, single-wythe masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.2 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat or primer and one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

E. Concrete Backup for Brick Veneer Assemblies, Stone Veneer Assemblies and Dimension Stone Cladding: Apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

F. Masonry Backup for Brick Veneer Assemblies, Stone Veneer Assemblies and Dimension Stone Cladding: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

G. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or primer and one trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).

C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

E. Concrete Backup for Brick Veneer Assemblies, Stone Veneer Assemblies and Dimension Stone Cladding: Apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

F. Masonry Backup for Brick Veneer Assemblies, Stone Veneer Assemblies and Dimension Stone Cladding: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

G. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

H. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

I. Interior Face of Single-Wythe, Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.4 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

END OF SECTION 071113

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing.
2. Modified bituminous sheet waterproofing, fabric reinforced.
3. Pedestal-supported plaza-deck pavers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Three, Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Physical Properties:

a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D1970/D1970M.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C836/C836M.
e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E154/E154M.
f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
g. Water Vapor Permeance: 0.05 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E96/E96M, Water Method.
h. Hydrostatic-Head Resistance: 200 feet (60 m) minimum; ASTM D5385.

2. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

B. Modified Bituminous Sheet, Fabric Reinforced: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of rubberized-asphalt membrane with embedded fabric reinforcement, and with release liner on adhesive side.

1. Physical Properties:

a. Pliability: No cracks when bent 180 degrees over a 1-inch (25-mm) mandrel at minus 25 deg F (minus 32 deg C); ASTM D146/D146M.
b. Puncture Resistance: 40 lbf (180 N), 100 lbf (445 N), minimum; ASTM E154/E154M.

c. Water Vapor Permeance: 0.05 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E96/E96M, Water Method.

2. Sheet Strips: Self-adhering, reinforced, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne, solvent-borne, primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm), predrilled at 9-inch (229-mm) centers.

G. Protection Course: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: Nominal 1/8 inch (3 mm), 1/4 inch (6 mm), 1/8 inch (3 mm) for vertical applications; 1/4 inch (6 mm) elsewhere.
2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

H. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side or both sides with plastic film, nominal thickness 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) per ASTM D1621, and maximum water absorption by volume of 0.6 percent per ASTM C272/C272M.

I. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C578, Type X, 1/2 inch (13 mm) thick.

J. Protection Course: Molded-polystyrene board insulation, ASTM C578, Type I, 0.90-lb/cu. ft. (15-kg/cu. m) minimum density, 1-inch (25-mm) minimum thickness.

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core and a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft. (35 L/min. per m).

D. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft. (35 L/min. per m).

2.4 INSULATION DRAINAGE PANELS

A. Insulation: Comply with Section 072100 "Thermal Insulation" for general building insulation, including insulation drainage panels.

B. Unfaced, Wall-Insulation Type IV, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

C. Unfaced, Wall-Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

D. Geotextile-Faced, Wall-Insulation Type IV, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive

strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.

E. Geotextile-Faced, Wall-Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.

F. Unfaced, Plaza-Deck Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.

G. Unfaced, Plaza-Deck Insulation Type VII, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.

H. Geotextile-Faced, Plaza-Deck Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven geotextile filter fabric.

I. Geotextile-Faced, Plaza-Deck Insulation Type VII, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven geotextile filter fabric.

2.5 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Brick, Concrete, Asphalt-block, pavers specified in Section 321400 "Unit Paving."

B. Stone Plaza-Deck Pavers: Granite, Limestone, Marble, Quartz-based stone, Slate, Travertine, pavers specified in Section 321400 "Unit Paving."

C. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard-weight concrete units, square edged, with top edges beveled 3/16 inch (5 mm), manufactured for use as plaza-deck pavers; 7500-psi (52-MPa), 6500-psi (45-MPa) minimum compressive strength, ASTM C140/C140M; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.
   1. Thickness: 2 inches (51 mm), 2-3/8 inches (60 mm).
   2. Face Size: 12 inches (305 mm) square, 12 by 24 inches (305 by 610 mm), 18 inches (457 mm) square, 24 inches (610 mm) square, As indicated.

3. Color and Texture: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

D. Paver Pedestals: Paver-support assembly, standard with paver manufacturer or as named below, including, fixed-height, adjustable or stackable, pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm), 1/8 to 3/16 inch (3 to 5 mm).
1. Fill: As recommended in writing by pedestal manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

3.2 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

1. Molded-sheet drainage panels, Insulation drainage panels, Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.3 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation, protection course before installing drainage panels.

3.4 INSULATION DRAINAGE-PANEL INSTALLATION

A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 PLAZA-DECK PAVER INSTALLATION

A. Install pavers according to manufacturer's written instructions.

B. Install paver pedestals and accessories to required elevations. Adjust for final level and slope of paved surfaces.

C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Install pavers to vary no more than 1/16 inch (1.6 mm) in elevation between adjacent pavers and no more than 1/16 inch (1.6 mm) from surface plane elevation of individual paver.

E. Limit variation in paving installation to within 1/4 inch in 10 feet (6 mm in 3 m) of surface plane in any direction; noncumulative.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071353 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. EPDM rubber sheet waterproofing.
2. Pedestal-supported plaza-deck pavers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: 10, 20, and or as directed years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET WATERPROOFING

A. EPDM Rubber Sheet: ASTM D6134, Type I, 60-mil- (1.5-mm-) thick flexible sheet, unreinforced, formed from EPDM.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing or 60-mil- (1.5-mm-) thick, uncured EPDM, as required by manufacturer.

C. Exposed Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, cured or uncured, as required by manufacturer.

D. Bonding Adhesives: For bonding waterproofing sheets and sheet flashings to substrates and projections.

E. Splicing Cement and Cleaner: Single-component butyl splicing cement and solvent-based splice cleaner.

1. Butyl Gum Tape: 30-mil- (0.76-mm-) thick-by-6-1/4-inch- (160-mm-) wide, uncured butyl with polyethylene release film.

F. Lap Sealant: Single-component sealant.

G. In-Seam Sealant: Single-component sealant.

H. Water-Cutoff Mastic: Butyl mastic sealant.

I. Waterproofing and Sheet-Flashing Accessories: Sealants, pourable sealers, cone and vent flashings, inside and outside corner flashings, termination reglets, and other accessories recommended by waterproofing manufacturer for intended use.

J. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch (25 mm) wide, prepunched, with fasteners.

K. Protection Course: Semirigid sheets of asphalt-impregnated organic mat, mineral surface, with a nominal thickness of 1/8 inch (3 mm).

L. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation, a nominal thickness of 1/4 inch (6 mm), and a compressive strength of not less than 8 psi (55 kPa).

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

C. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core and a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft. (35 L/min. per m).

D. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel without Polymeric Film: Composite subsurface drainage panel acceptable to waterproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft. (35 L/min. per m).

2.4 INSULATION DRAINAGE PANELS

A. Insulation: Comply with Section 072100 "Thermal Insulation" for general building insulation, including insulation drainage panels.

B. Unfaced, Wall-Insulation Type IV, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

C. Unfaced, Wall-Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

D. Geotextile-Faced, Wall-Insulation Type IV, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.

E. Geotextile-Faced, Wall-Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.

F. Unfaced, Plaza-Deck Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.

G. Unfaced, Plaza-Deck Insulation Type VII, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; unfaced; fabricated with shiplapped, channel, or tongue-and-groove edges and with one side having ribbed drainage channels.

H. Geotextile-Faced, Plaza-Deck Insulation Type VI, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven geotextile filter fabric.

I. Geotextile-Faced, Plaza-Deck Insulation Type VII, Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven geotextile filter fabric.

2.5 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Brick, Concrete, Asphalt-block, pavers specified in Section 321400 "Unit Paving."

B. Stone Plaza-Deck Pavers: Granite, Limestone, Marble, Quartz-based stone, Slate, Travertine, pavers specified in Section 321400 "Unit Paving."

C. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard-weight concrete units, square edged, with top edges beveled 3/16 inch (5 mm), manufactured for use as plaza-deck pavers; 7500-psi (52-MPa), 6500-psi (45-MPa) minimum compressive strength, ASTM C140/C140M; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.
   1. Thickness: 2 inches (51 mm), 2-3/8 inches (60 mm).
   2. Face Size: 12 inches (305 mm) square, 12 by 24 inches (305 by 610 mm), 18 inches (457 mm) square, 24 inches (610 mm) square, As indicated, dimension(s) and shape.
   3. Color and Texture: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

D. Paver Pedestals: Paver-support assembly, standard with paver manufacturer or as named below, including fixed-height, adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm), 1/8 to 3/16 inch (3 to 5 mm).
   1. Fill: As recommended in writing by pedestal manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

3.2 FULLY ADHERED SHEET INSTALLATION

A. Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and per recommendations in ASTM D5843.

B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.

C. Apply bonding adhesive to substrates at required rate and allow it to partially dry.

D. Apply bonding adhesive to sheets and firmly adhere sheets to substrates. Do not apply bonding adhesive to splice area of sheet.

E. Install fully adhered sheets and auxiliary materials to tie into existing waterproofing.

F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

G. Horizontal Application: Apply sheets with side laps shingled with slope of deck where possible.

1. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.

3.3 PARTIALLY ADHERED SHEET INSTALLATION

A. Install partially adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.

B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.

C. Apply bonding adhesive to the following areas of substrates and to each sheet at required rate and allow it to partially dry:

1. Upper 25 percent of length of each sheet and 18 inches (457 mm) around perimeter of each sheet.

D. Firmly adhere sheets to substrate. Do not apply bonding adhesive to splice area of sheet.

E. Install partially adhered sheets and auxiliary materials to tie into existing waterproofing.

F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.4 COMPARTMENTED, LOOSELY LAID SHEET INSTALLATION

A. Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.

B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.

C. Apply continuous beads of water-cutoff mastic, of size recommended in writing by waterproofing manufacturer, to substrates in a 60-by-60-inch (1500-by-1500-mm) grid pattern before installing sheet.

D. Apply sheets with side laps shingled with slope of deck where possible.

E. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.

F. Install compartmented, loosely laid sheets and auxiliary materials to tie into existing waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.5 SEAM INSTALLATION

A. Cement Splice: Clean splice areas, apply splicing cement and in-seam sealant, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to produce a splice not less than 6 inches (150 mm) wide and to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.

B. Cement and Tape Splice: Clean splice areas, apply splicing cement and butyl gum tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.

3.6 SHEET-FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.

B. Form wall flashings using exposed sheet flashing.

C. Extend deck sheet waterproofing to form wall flashings.

1. Flash penetrations and field-formed inside and outside corners with uncured sheet flashing.
2. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal edges of sheet-flashing terminations.

D. Cover expansion joints and discontinuous deck-to-wall or deck-to-deck joints by extending deck sheet waterproofing over joints.

E. Terminate and seal top of sheet flashings with mechanically anchored termination bars.

3.7 PROTECTION COURSE INSTALLATION

A. Install protection course over waterproofing membrane according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.

1. Molded-sheet drainage panels, Insulation drainage panels, Board insulation may be used in place of a separate protection course for vertical applications when approved by waterproofing manufacturer.

3.8 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation, protection course before installing drainage panels.

3.9 INSULATION DRAINAGE-PANEL INSTALLATION

A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.10 PLAZA-DECK PAVER INSTALLATION

A. Install pavers according to manufacturer's written instructions.

B. Install paver pedestals and accessories to required elevations. Adjust for final level and slope of paved surfaces.

C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Install pavers to vary no more than 1/16 inch (1.6 mm) in elevation between adjacent pavers and no more than 1/16 inch (1.6 mm) from surface plane elevation of individual paver.

E. Limit variation in paving installation to within 1/4 inch in 10 feet (6 mm in 3 m) of surface plane in any direction; noncumulative.

3.11 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071353

SECTION 071354 - THERMOPLASTIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC sheet waterproofing for horizontal installations.
2. Pedestal-supported plaza-deck pavers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1. Include layout drawings showing locations of submembrane containment strips and control test drains.
2. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for Manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five, 10, 20 and or as directed, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PVC SHEET WATERPROOFING

A. PVC Sheet: 60-mil- (1.5-mm-), 80-mil- (2.0-mm-), thick, PVC membrane with integral pigments, stabilizers, UV absorbers, biocide, and nonwoven fiberglass reinforcement.

B. Self-Adhered PVC Sheet: 120-mil- (3.0-mm-) thick, composite sheet composed of 60-mil- (1.5-mm-) thick, PVC membrane with integral pigments, stabilizers, biocide, and nonwoven fiberglass reinforcement; a 60-mil- (1.5-mm-) thick, nonpermeable, closed-cell-foam backing layer; and a pressure-sensitive adhesive coating.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing.

C. Exposed Sheet Flashing: PVC-sheet flashing 60 mils (1.5 mm), 80 mils (2.0 mm), 96 mils (2.4 mm) thick; PVC with integral pigments, stabilizers, UV absorbers, and biocide; reinforced with nonwoven fiberglass.

D. Surface Conditioner: Manufacturer's standard waterborne surface treatment to bind residual surface dust and efflorescence to substrate.

E. Bonding Adhesives: For bonding waterproofing sheets, containment strips, and PVC-sheet flashings to substrates.

F. Containment Strip: Manufacturer's standard asphalt-resistant, 60-mil- (1.5-mm-) thick, PVC strip; reinforced with nonwoven fiberglass; 12 inches (300 mm) wide.

G. Geotextile Leveling Layer: Manufacturer's standard 0.22-inch- (5.59-mm-) thick, nonwoven polypropylene fabric.

H. Separation Layer: Manufacturer's standard 0.16-inch- (4.06-mm-) thick, nonwoven polypropylene fabric.

I. Protection Course: 39-mil- (1.0-mm-) thick, HDPE sheet or 51-mil- (1.3-mm-) thick, hot-air-weldable, PVC sheet, protection layer.

J. Waterproofing and Sheet-Flashing Accessories: Sealants, pourable sealers, termination reglets, clamps, compression bars, tapes, preformed cone and stack flashings, and other accessories recommended by waterproofing manufacturer for intended use.

K. Control Test Drain: Manufacturer's standard assembly to verify the absence or presence of leaks from underside of waterproofed slab.

L. Metal Termination Bars: Manufacturer's standard stainless-steel or aluminum bars, pre-punched, with noncorrosive fasteners.

2.3 DRAINAGE PANELS

A. Composite Drainage Panels: Drainage panel acceptable to waterproofing manufacturer and consisting of a nonbiodegradable core of fused, entangled filaments or a three-dimensional drainage net; with a geotextile facing on both sides.

2.4 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Brick, Concrete, Asphalt-block, pavers specified in Section 321400 "Unit Paving."

B. Stone Plaza-Deck Pavers: Granite, Limestone, Marble, Quartz-based stone, Slate, Travertine, pavers specified in Section 321400 "Unit Paving."

C. Concrete Plaza-Deck Pavers: Solid, hydraulically pressed, standard-weight concrete units, square edged, with top edges beveled 3/16 inch (5 mm), manufactured for use as plaza-deck pavers; 7500-psi (52-MPa), 6500-psi (45-MPa) minimum compressive strength, ASTM C140/C140M; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.
   1. Thickness: 2 inches (51 mm), 2-1/2 inches (64 mm).
   2. Face Size: 12 inches (305 mm) square, 12 by 24 inches (305 by 610 mm), 18 inches (457 mm) square, 24 inches (610 mm) square, As indicated, dimension(s) and shape.
   3. Color and Texture: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

D. Paver Pedestals: Paver-support assembly, standard with paver manufacturer or named below, including fixed-height, adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm), 1/8 to 3/16 inch (3 to 5 mm).
   1. Fill: As recommended in writing by pedestal manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

3.2 FULLY ADHERED SHEET INSTALLATION

A. Install self-adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.

   1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
   2. Install laps shingled with slope of deck where possible.
   3. Install flashings concurrently with deck sheet.
   4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
   5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
   6. Install sheets and auxiliary materials to tie into adjoining waterproofing.

B. Apply surface conditioner, at required rate, to substrates to receive waterproofing. Apply only at temperatures greater than 25 deg F (minus 4 deg C) and rising.

C. Apply and firmly adhere sheets to substrate; butt adjoining sheets tightly. Apply only when the membrane, air, and substrate temperatures are greater than 40 deg F (5 deg C) and rising. Apply a minimum 8-inch- (203-mm-) wide cover strip centered over joints and lap edges; hot-air weld cover strip to deck sheet.

D. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or square patch.

E. Unless terminations and deck-sheet waterproofing perimeter are sealed with flashings, secure them with mechanically anchored metal termination bar. Seal edge of termination with sealant.

F. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over deck sheet according to membrane manufacturer's written instructions, and hot-air-weld flashing to deck sheet; securely seal flashing sheet in place with clamping ring.

G. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.3 LOOSELY LAID SHEET INSTALLATION

A. Install loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.

1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
2. Install laps shingled with slope of deck where possible.
3. Install flashings concurrently with deck sheet.
4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
6. Install sheets and auxiliary materials to tie into adjoining waterproofing.

B. Install geotextile leveling layer over entire area to receive deck sheet. Lap edges at least 4 inches (102 mm) and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric using scissors or utility blades; do not use welding equipment to cut fabric.

C. Apply deck sheet over area, lapping edges at least 3 inches (76 mm) for machine welding or at least 4 inches (102 mm) for hand welding. Hot-air weld sheets.

D. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or square patch.

E. Secure perimeter of deck sheet with manufacturer's standard metal termination bars and accessories as recommended by manufacturer for each condition.

F. At deck drains, spread sealant bed over drain flange and lap membrane into drain flange according to membrane manufacturer's written instructions; securely seal sheets in place with clamping ring.

G. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.4 COMPARTMENTED, LOOSELY LAID SHEET INSTALLATION

A. Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.

1. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
2. Install laps shingled with slope of deck where possible.
3. Install flashings concurrently with deck sheet.
4. Perform hot-air welding to ensure a watertight seam installation. Inspect outside edge of seams with pointed metal probe and ensure completed laps lay flat and are free of voids, fishmouths, or wrinkles.
5. Install temporary cut-offs if work is interrupted. Remove the cut-offs completely before proceeding with the installation.
6. Install sheets and auxiliary materials to tie into adjoining waterproofing.

B. Construct a test containment grid before beginning installation. Perform manufacturer's recommended peel test on the test containment grid and on each day's completed waterproofing work before resuming the following day's installation.

C. Install submembrane containment grid to form compartments secured by containment strips. Also, install containment strips at the base of walls, curbs, penetrations, terminations, and transitions and at the perimeter of the installation. Secure containment grid to substrate with bonding adhesive.

D. Install geotextile leveling layer over entire area between containment strips. Lap edges at least 4 inches (102 mm) and spot adhere fabric to deck as required to keep in position as waterproofing sheet is placed in position. Trim fabric even with edges of containment strips using scissors or utility blades; do not use welding equipment to cut fabric.

E. Control-Test-Drain Installation: Drill 1-inch- (25-mm-) diameter hole through the substrate at or near the low point of each compartment and install control test drain, according to manufacturer's written instructions, so as to enable verification of the absence or presence of leaks from underside of waterproofed slab.

F. Apply deck sheet over area, lapping edges at least 3 inches (76 mm) for machine welding or at least 4 inches (102 mm) for hand welding. Hot-air weld the sheet to containment strips.

G. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or square patch.

H. Install flashing at deck drains. Spread sealant bed over deck drain flange, lap flashing membrane into drain flange and over containment strips according to membrane manufacturer's written instructions, and hot-air weld flashing to containment strips; securely seal flashing sheet in place with clamping ring.

I. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.5 SHEET-FLASHING INSTALLATION

A. Form wall flashings exposed in final construction using exposed sheet flashing; otherwise, use concealed sheet flashing.

B. Lap sheet flashings over deck sheet or containment strips. Flash penetrations and field-formed inside and outside corners with sheet flashing.

C. Extend flashings a minimum of 8 inches (203 mm) above the overburden unless otherwise indicated on Drawings and acceptable to waterproofing manufacturer.

D. Hot-air weld joints with deck sheet or containment strips and end laps of overlapping sheet flashings and accessories to ensure a watertight seam installation.

E. Hot-air weld three-way overlaps or T-joints with a 4-inch- (102-mm-) round or square patch.

F. Secure flashings along top edge with mechanically anchored metal termination bar or with mechanically anchored metal reglet for subsequent metal counterflashing. Seal top of termination with sealant.

G. Terminate deck sheet at expansion joints and discontinuous deck-to-wall or deck-to-deck joints. Bridge and cover joints with sheet flashing and joint accessories according to manufacturer's written instructions for each type of joint.

3.6 PROTECTION COURSE INSTALLATION

A. Install separation layer over sheet waterproofing before placing protection course.

B. Install protection course over sheet waterproofing, separation layer according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.

3.7 DRAINAGE-PANEL INSTALLATION

A. Place and secure drainage panels directly over the waterproofing membrane, according to waterproofing manufacturer's written instructions.

B. Trim drainage panels to fit closely around penetrations and at the base of drains to ensure that water flows freely from composite into drain openings.

C. Cover cut edges of drainage panels to protect waterproofing membrane from damage.

3.8 PLAZA-DECK PAVER INSTALLATION

A. Install pavers according to manufacturer's written instructions.

B. Install paver pedestals and accessories to required elevations. Adjust for final level and slope of paved surfaces.

C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Install pavers to vary no more than 1/16 inch (1.6 mm) in elevation between adjacent pavers and no more than 1/16 inch (1.6 mm) from surface plane elevation of individual paver.

E. Limit variation in paving installation to within 1/4 inch in 10 feet (6 mm in 3 m), of surface plane in any direction; noncumulative.

3.9 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071354

SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubberized-asphalt waterproofing membrane, unreinforced, reinforced.
2. Molded-sheet drainage panels.
3. Insulation.
4. Plaza-deck pavers supported on pedestals.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.

C. Samples: For plaza-deck pavers, full sized in each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty Period: Five, 10 and or as directed, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

2.2 AUXILIARY MATERIALS

A. Primer: ASTM D41/D41M, asphaltic primer.

B. Elastomeric Sheet: 50-mil- (1.3-mm-) minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives as follows:

1. Tensile Strength: 1400 psi (9.6 MPa) minimum; ASTM D412, Die C.
2. Elongation: 300 percent minimum; ASTM D412.
3. Tear Resistance: 125 psi (860 kPa) minimum; ASTM D624, Die C.
4. Brittleness: Does not break at minus 30 deg F (34 deg C); ASTM D2137.

C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum termination bars; approximately 1 by 1/8 inch (25 by 3 mm) thick; with stainless-steel anchors.

D. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

F. Protection Course: ASTM D6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: 1/8 inch (3 mm), 1/4 inch (6 mm), nominal.
2. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.

G. Protection Course: Manufacturer's standard, 80- to 90-mil- (2.0- to 2.3-mm-) thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.

2.3 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve, laminated to one side with or without a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-

plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm/ft. (112 to 188 L/min. per m).

B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side with or without a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm/ft. (35 L/min. per m).

2.4 INSULATION

A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C578, Type IV, 25-psi (173-kPa), Type VI, 40-psi (276-kPa), Type VII, 60-psi (414-kPa), Type V, 100-psi (690-kPa) minimum compressive resistance, square or shiplap edged.

2.5 PLAZA-DECK PAVERS

A. Plaza-Deck Pavers: Heavyweight, hydraulically pressed, concrete units, square edged, with top edges beveled 3/16 inch (5 mm), manufactured for use as plaza-deck pavers; minimum compressive strength 7500 psi (52 MPa), 6500 psi (45 MPa), ASTM C140; absorption not greater than 5 percent, ASTM C140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.
   1. Thickness: 1-5/8 inches (41 mm), 1-3/4 inches (45 mm), 2 inches (51 mm), 2-3/8 inches (60 mm).
   2. Face Size: 8-7/8 inches (225 mm) square, 9 inches (229 mm) square, 9 by 18 inches (229 by 457 mm), 12 inches (305 mm) square, 12 by 24 inches (305 by 610 mm), 18 inches (457 mm) square, 24 inches (610 mm) square, As indicated, dimensions and shape.
   3. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

B. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height, adjustable or stackable, pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm), 1/8 to 3/16 inch (3 to 5 mm).

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

3.2 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches (150 mm) on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch (3 mm) thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
2. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches (150 mm) on each side of nonmoving joints and cracks not exceeding 1/8 inch (3 mm) thick, and beyond roof drains and penetrations.

    a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches (150 mm) on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.3 FLASHING INSTALLATION

A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

3.4 MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

C. Unreinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to form a uniform, unreinforced, seamless membrane, 180-mil (4.5-mm) minimum thickness, 180-mil (4.5-mm) average thickness, but not less than 125 mils (3.2 mm) thick.

D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils (2.3 mm); embed reinforcing fabric, overlapping sheets 2 inches (50 mm); spread another 125-mil- (3.2-mm-) thick layer to provide a uniform, reinforced, seamless membrane 215 mils (5.5 mm) thick.

E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

F. Cover waterproofing with protection course with overlapped joints before membrane is subject to backfilling, construction or vehicular traffic.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation, protection course, before installing drainage panels.

3.6 INSULATION INSTALLATION

A. On vertical surfaces, set insulation units into rubberized asphalt according to manufacturer's written instructions.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.7 PLAZA-DECK PAVER INSTALLATION

A. Install concrete pavers according to manufacturer's written instructions.

B. Accurately install fixed, adjustable-height paver pedestals and accessories to elevations required. Adjust for final level and slope with shims.

C. Loosely lay pavers on pedestals, maintaining a uniform open joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

D. Install pavers to not vary more than 1/16 inch (1.6 mm) in elevation between adjacent pavers or more than 1/16 inch (1.6 mm) from surface plane elevation of individual paver.

E. Limit variation in paving installation to within 1/4 inch in 10 feet (6 mm in 3 m), of surface plane in any direction; noncumulative.

3.8 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071413

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing.
2. Rubber waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five, 10 and or as directed, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C836/C836M and coal-tar free.

B. Two-Component, Unmodified Polyurethane Waterproofing: ASTM C836/C836M.

2.2 RUBBER WATERPROOFING

A. Two-Component, Reinforced, Rubber Waterproofing: ASTM C836/C836M; coal-tar free.
   1. Hydrostatic-Head Resistance: 197 feet (60 m)minimum ASTM D5385/D5385M.

2.3 AUXILIARY MATERIALS

A. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

B. Sheet Flashing: 50-mil- (1.3-mm-) minimum, non-staining, uncured sheet neoprene.

   1. Adhesive: Manufacturer's recommended contact adhesive.

C. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric.

D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.

   1. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

A. Protection Course: ASTM D6506, semirigid sheets of fiberglass- or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
   1. Thickness: 1/8 inch (3 mm), 1/4 inch (6 mm), nominal.
   2. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
   3. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer.

B. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness of 1/4 inch (6 mm), with compressive strength of

not less than 8 psi (55 kPa) according to ASTM C1621/C1621M and maximum water absorption by volume of 0.6 percent according to ASTM C272/C272M.

C. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on both sides with plastic film, nominal thickness of 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) according to ASTM C1621/C1621M and maximum water absorption by volume of 0.6 percent according to ASTM C272/C272M.

D. Protection Course: Molded-polystyrene board insulation, ASTM C578, Type I, 0.90-lb/cu. ft. (15-kg/cu. m) minimum density, 1-inch (25-mm) minimum thickness.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft. (112 to 261 L/min. per m).

B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core and a polymeric film bonded to the other side; and with a horizontal flow rate through the core of not less than 2.8 gpm per ft. (35 L/min. per m).

2.6 INSULATION DRAINAGE PANELS

A. Unfaced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

B. Unfaced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

C. Geotextile-Faced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.

D. Geotextile-Faced, Wall-Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength;

fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.

E. Unfaced, Plaza-Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

F. Unfaced, Plaza-Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; unfaced; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

G. Geotextile-Faced, Plaza-Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven-geotextile filter fabric.

H. Geotextile-Faced, Plaza-Deck, Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven-geotextile filter fabric.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

F. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M.

G. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

H. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

I. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

3.2 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471/C1471M.

B. Unreinforced Waterproofing Applications.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm), 90 mils (2.25 mm), 120 mils (3 mm).

C. Reinforced Waterproofing Applications.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 70 mils (1.8 mm), 80 mils (2 mm), 120 mils (3 mm).

D. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For horizontal applications, install protection course loose laid over fully cured membrane.
2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
3. Molded-sheet drainage panels, Insulation drainage panels, Thermal insulation specified in Section 072100 "Thermal Insulation" may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.3 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that

does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install thermal insulation specified in Section 072100 "Thermal Insulation", protection course before installing drainage panels.

3.4 INSULATION DRAINAGE PANEL INSTALLATION

A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 071416

SECTION 071613 - POLYMER MODIFIED CEMENT WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes polymer-modified cement waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 PREPACKAGED, POLYMER-MODIFIED CEMENT WATERPROOFING

A. Negative-Side, Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with water or polymer admixture to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists negative-side hydrostatic pressure, and has properties complying with or exceeding the criteria specified below.
   1. Water Permeability: Maximum zero for water at 30 feet (9 m), when tested according to COE CRD-C 48.
   2. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.
   3. Flexural Strength: Minimum 710 psi (4.8 MPa) at 28 days when tested according to ASTM C348.
   4. Bond Strength: Minimum 220 psi (1.5 MPa) at 14 days when tested according to ASTM C321.
   5. Color: White, Gray, Match Architect's samples, As selected by Architect from full range, As indicated in a color schedule.

B. Positive-Side Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with water or polymer admixture to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists positive-side hydrostatic pressure, and has properties complying with or exceeding the criteria specified below.
   1. Water Permeability: Maximum zero for water at 30 feet (9 m), when tested according to COE CRD-C 48.
   2. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.
   3. Flexural Strength: Minimum 710 psi (4.8 MPa) at 28 days when tested according to ASTM C348.
   4. Bond Strength: Minimum 220 psi (1.5 MPa) at 14 days when tested according to ASTM C321.
   5. Color: White, Gray, Match Architect's samples, As selected by Architect from full range, As indicated in a color schedule.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Portland Cement: ASTM C150/C150M, Type I.

D. Slurry-Coat and Protective-Topping Sand: ASTM C144.

E. Trowel-Coat Sand: ASTM C33/C33M, fine aggregate.

F. Protective-Topping Sand: ASTM C144.

G. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and to not create a vapor barrier.

H. Water: Potable.

2.3 MIXES

A. Prepackaged Polymer-Modified Cement Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

B. Protective Topping: Measure, batch, and mix portland cement and sand in the proportion of 1:3, and water gaged with a polymer admixture. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch (25 mm) deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

3.2 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

a. Onto columns integral with treated walls.
b. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches (600 mm) for cast-in-place concrete and 48 inches (1200 mm) for masonry.
c. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches (300 mm), where floors, but not walls, are treated.
d. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps and similar offsets and features.

3. Number of Coats: Number required for specified water permeability Two, Three.

a. Coating Thickness: Maximum application thickness of 47 mils (1.2 mm) per coat for total thickness as required for specified water permeability of 100 mils (2.5 mm).
b. Apply first coat as a slurry with brush or roller, and apply subsequent coats with brush, roller, spray, or trowel.
c. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.
d. Allow manufacturer's recommended time between coats. Dampen surface between coats.

B. Final Coat Finish: Smooth troweled, Brushed, Textured.

C. Curing: Cure waterproofing for not less than five, days immediately after application and prior to being placed in service.

D. Curing: Moist-cure waterproofing for not less than three, days immediately after application has set, followed by air drying prior to being placed in service unless otherwise recommended in writing by manufacturer.

E. Protective Topping: Apply 1-inch- (25-mm-) thick, protective topping over floor surfaces. Moist-cure topping for not less than three days.

END OF SECTION 071613

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes crystalline waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, gray, white-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

1. Water Permeability: Maximum zero for water at 30 feet (9 m) when tested according to COE CRD-C 48.
2. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch (25 mm) deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

3.2 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

    a. Onto columns integral with treated walls.
    b. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches (600 mm) for cast-in-place concrete and 48 inches (1200 mm) for masonry.
    c. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches (300 mm), where floors, but not walls, are treated.
    d. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps and similar offsets and features.

3. Number of Coats: Number required for specified water permeability, Two, Three.
4. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
5. Dampen surface between coats.

B. Final Coat Finish: Smooth, Brushed Spray textured.

C. Curing: Moist-cure waterproofing for three, days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

END OF SECTION 071616

SECTION 071619 - METAL OXIDE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal-oxide waterproofing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying metal-oxide waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Metal-Oxide Waterproofing Compound: A product specifically formulated for waterproofing concrete and masonry substrates and containing pulverized iron and a chemical oxidizing agent to cause the iron particles to rust and grow in size in the presence of water.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Portland Cement: ASTM C150/C150M, Type I.

D. Sand: ASTM C144.

E. Water: Potable.

2.3 MIXES

A. Metal-Oxide Coats: Add metal-oxide waterproofing compound and other mix components, if any, to water according to manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency for each coat.

B. Protection Coat and Floor Topping: Measure, batch, and mix portland cement and sand in the proportion of 1:2-1/2 and water. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch (1.6 mm) wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch (25 mm) deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

3.2 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

    a. Onto columns integral with treated walls.
    b. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches (600 mm) for cast-in-place concrete and 48 inches (1200 mm) for masonry.
    c. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches (300 mm), where floors, but not walls, are treated.
    d. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps and similar offsets and features.

3. Number of Metal-Oxide Coats: Number required for specified water permeability, Two, Three.
4. Application Method: Brush apply the waterproofing, vigorously working first coat onto the substrate and forcing the material into surface voids. Brush each subsequent coat into full contact with previous coat.
5. Dampen surface between coats.
6. Allow each coat to set for 24 hours between coats.

B. Protection Coat: Immediately after metal-oxide coats have set, apply protection coat on walls to a thickness of 1/8 inch (3 mm).

1. Finish: Smooth, Brushed, Textured.

C. Protective Topping: Immediately after metal-oxide coats have set, apply floor topping to a thickness of 1 inch (25 mm).

1. Finish: Smooth, Brushed.

D. Curing: Moist-cure waterproofing for three, days immediately after installation has set, followed by air drying prior to being placed in service, unless otherwise recommended in writing by manufacturer.

END OF SECTION 071619

SECTION 071700 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bentonite waterproofing.
2. Molded-sheet drainage panels.
3. Insulation drainage panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include installation details for waterproofing, penetrations, and interface with other work.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Sample warranty.

1.5 WARRANTY

A. Special Warranty: Manufacturer and Installer agree(s) to repair or replace components of bentonite waterproofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five, 10 and or as directed, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GEOTEXTILE/BENTONITE SHEETS

A. Regular Geotextile/Bentonite Sheet: Minimum of 1.0 lb/sq. ft. (5 kg/sq. m) of bentonite clay granules between two layers of polypropylene geotextile fabric, one woven and one nonwoven, needle punched and heat fused together.
   1. Grab Tensile Strength: 95 lbf (422 N) according to ASTM D4632.
   2. Puncture Resistance: 100 lbf (445 N) according to ASTM D4833.

B. Contaminant-Resistant Geotextile/Bentonite Sheet: Minimum of 1.0 lb/sq. ft. (5 kg/sq. m) of bentonite clay granules, specially formulated for use in saltwater or contaminated ground water, between two layers of polypropylene geotextile fabric, one woven and one nonwoven, needle punched and heat fused together.
   1. Grab Tensile Strength: 95 lbf (422 N) according to ASTM D4632.
   2. Puncture Resistance: 100 lbf (445 N) according to ASTM D4833.

2.2 COMPOSITE POLYETHYLENE/BENTONITE MEMBRANE

A. Composite Polyethylene/Bentonite Membrane: Minimum 90-mil- (2.3-mm-) thick membrane consisting of a polyethylene geomembrane bonded to a layer of bentonite.
   1. Puncture Resistance: 70 lbf (311 N) according to ASTM D4833 or 169 lbf (752 N) according to ASTM E154.
   2. Vapor Permeance: 0.03 perms according to ASTM E96/E96M.

B. Composite Polyethylene/Bentonite Membrane with Protective Facing: Minimum 170-mil- (4.3-mm-) thick membrane consisting of polyethylene geomembrane bonded to a layer of bentonite and with a protective, nonwoven-geotextile facing.
   1. Puncture Resistance: 130 lbf (578 N) according to ASTM D4833 or 169 lbf (752 N) according to ASTM E154.
   2. Vapor Permeance: 0.03 perms according to ASTM E96/E96M.

C. Contaminant-Resistant Composite Polyethylene/Bentonite Membrane: Minimum 100-mil- (2.3-mm-) thick membrane consisting of polyethylene geomembrane bonded to a layer of bentonite.
   1. Puncture Resistance: 70 lbf (311 N) according to ASTM D4833 or 169 lbf (752 N) according to ASTM E154.
   2. Vapor Permeance: 0.03 perms according to ASTM E96/E96M.

2.3 BENTONITE-FILLED PAPER PANELS

A. Bentonite Panels: 3/16-inch- (5-mm-) thick, corrugated kraft-paper panels with a minimum of 1.0 lb/sq. ft. (5 kg/sq. m) of bentonite confined in corrugations of boards.

2.4 PROTECTION COURSE

A. Protection Course: Protection mat of type and thickness as recommended in writing by waterproofing manufacturer for each Project condition.

1. Adhesive: As recommended in writing by waterproofing manufacturer.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core, with or without a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

B. Woven-Geotextile-Faced Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, with or without a polymeric film bonded to the other side; and with a horizontal flow rate of not less than 2.8 gpm per ft. (35 L/min. per m).

2.6 INSULATION DRAINAGE PANELS

A. Insulation Drainage Panels, General: Comply with Section 072100 "Thermal Insulation" for general building insulation, including insulation drainage panels.

B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

C. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven-geotextile filter fabric.

D. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

E. Unfaced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with shiplapped or channel edges and with one side having ribbed drainage channels.

F. Geotextile-Faced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven-geotextile filter fabric.

G. Geotextile-Faced Plaza-Deck Insulation Drainage Panels: Extruded-polystyrene board insulation according to ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; fabricated with tongue-and-groove edges, with one side having grooved drainage channels, and faced with manufacturer's standard, nonwoven-geotextile filter fabric.

2.7 ACCESSORIES

A. General: Manufacturer's standard accessories recommended for intended use and compatible with bentonite waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Prepare substrates, voids, cracks, and cavities; and install waterproofing and accessories according to manufacturer's written instructions.

B. Install protection course before backfilling or placing overburden when recommended in writing by waterproofing manufacturer.

3.2 GEOTEXTILE/BENTONITE SHEET INSTALLATION

A. Install a continuous layer of waterproofing sheets directly against surface to be waterproofed. Lap ends and edges a minimum of 4 inches (100 mm) on horizontal and vertical substrates unless otherwise indicated. Stagger end joints between sheets a minimum of 24 inches (600 mm). Fasten seams by stapling to adjacent sheet or nailing to substrate.

3.3 COMPOSITE POLYETHYLENE/BENTONITE MEMBRANE INSTALLATION

A. Install a continuous layer of waterproofing membrane, with ends and edges lapped a minimum of 4 inches (100 mm) unless otherwise indicated. Stagger end joints between membranes a minimum of 24 inches (600 mm). Seal joints with permanent seam tape.

3.4 BENTONITE-FILLED PAPER PANEL INSTALLATION

A. Install a continuous layer of bentonite panels, with ends and edges lapped a minimum of 1-1/2 inches (38 mm) unless otherwise indicated. Stagger joints in adjoining panel rows.

1. Install a double layer of bentonite panels, with ends and edges butted instead of lapped and with second layer of joints staggered over first. Staple panels together to hold them in place.

3.5 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels according to manufacturer's written instructions. Use adhesives or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation, protection course before installing drainage panels.

3.6 INSULATION DRAINAGE PANEL INSTALLATION

A. Install over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

END OF SECTION 071700

SECTION 071800 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes traffic coatings and pavement markings for the following applications:

1. Pedestrian traffic.
2. Vehicular traffic.
3. Equipment-room floor.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation instructions and details, material descriptions, dry or wet film thickness requirements, and finish.

B. Sustainable Design Submittals:

C. Shop Drawings: For traffic coatings.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.2 TRAFFIC COATING

A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for pedestrian traffic, vehicular traffic and equipment-room floor according to ASTM C957/C957M.

B. Primer: Liquid primer as recommended in writing for substrate and conditions by traffic-coating manufacturer.

C. Preparatory and Base Coats: Polyurethane or epoxy.

D. Intermediate Coat: Polyurethane or epoxy.

1. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.

E. Topcoat: Polyurethane, Aromatic urethane, Aliphatic urethane, Aromatic urethane with UV inhibitors or epoxy.

1. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated, As required to achieve slip-resistant finish.
2. Color: As selected by Architect from manufacturer's full range, Match Architect's sample.

F. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

G. Fire-Test-Response Characteristics: Provide traffic-coating materials with the fire-test-response characteristics as determined by testing identical products according to test method below for deck type and slopes indicated by an independent testing and inspecting agency that is acceptable to authorities having jurisdiction.

1. Class A, Class B, Class C roof covering according to ASTM E108.

2.3 ACCESSORY MATERIALS

A. Joint Sealants: As specified in Section 079200 "Joint Sealants." ASTM C920.

B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.

C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.

D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

2.4 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three, 45 minutes.

1. Color: White, Yellow, Blue, As indicated.

B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.

1. Color: White, Yellow, Blue, As indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application.

1. Application of coating indicates acceptance of surfaces and conditions.

B. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

C. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.
3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D4258.

3.2 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.3 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

1. Comply with recommendations in ASTM C1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.4 TRAFFIC-COATING APPLICATION

A. Apply traffic coating according to ASTM C1127 and manufacturer's written instructions.

B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.

C. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

D. Cure traffic coatings.

3.5 PAVEMENT MARKINGS

A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a minimum wet-film thickness of 15-mils (0.4-mm).

3.6 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071800

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Cast-in-place concrete.
2. Precast concrete.
3. Cast stone.
4. Concrete unit masonry.
5. Clay brick masonry.
6. Natural stone.
7. Portland cement plaster (stucco).

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of water repellent and substrate indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

B. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.

C. Siloxane, Penetrating Water Repellent: Clear, containing 10 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

D. Siloxane, Penetrating Water Repellent: Clear, containing 10 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 600 g/L or less of VOCs.

E. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.

F. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 600 g/L or less of VOCs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using low-pressure spray to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete and Cast Stone: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Polyisocyanurate foam-plastic board.
4. Glass-fiber blanket.
5. Glass-fiber board.
6. Mineral-wool blanket.
7. Mineral-wool board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards."

B. Extruded Polystyrene Board, Type X, ASTM C578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
   1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Extruded Polystyrene Board, Type IV, ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.
   1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Extruded Polystyrene Board, Type VI ASTM C578, Type VI, 40-psi (276-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

E. Extruded Polystyrene Board, Type VII ASTM C578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

F. Extruded Polystyrene Board, Type V ASTM C578, Type V, 100-psi (690-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E84.

2.2 MOLDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Molded Polystyrene Board, Type I ASTM C578, Type I, 10-psi (69-kPa) minimum compressive strength.

B. Molded Polystyrene Board, Type VIII ASTM C578, Type VIII, 13-psi (90-kPa) minimum compressive strength.

C. Molded Polystyrene Board, Type II ASTM C578, Type II, 15-psi (104-kPa) minimum compressive strength.

D. Molded Polystyrene Board, Type IX ASTM C578, Type IX, 25-psi (173-kPa) minimum compressive strength.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced ASTM C1289, foil faced, Type I, Class 1 or 2.
   1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.4 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

B. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

C. Glass-Fiber Blanket, Kraft Faced ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

D. Glass-Fiber Blanket, Reinforced-Foil Faced ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

E. Glass-Fiber Blanket, Foil Faced ASTM C665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.5 GLASS-FIBER BOARD

A. Glass-Fiber Board, Unfaced ASTM C612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84, passing ASTM E136 for combustion characteristics. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

B. Glass-Fiber Board, Faced ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

C. Glass-Fiber Board, Unfaced ASTM C612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84, passing ASTM E136 for combustion characteristics. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

D. Glass-Fiber Board, Faced ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

E. Glass-Fiber Board, Unfaced ASTM C612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84, passing ASTM E136 for combustion characteristics. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

F. Glass-Fiber Board, Faced ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Nominal density of 4.25 lb/cu. ft. (68 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

G. Glass-Fiber Board, Unfaced ASTM C612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84, passing ASTM E136 for combustion characteristics. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of 4.4 deg F x h x sq. ft./Btu x in. at 75 deg F (30.5 K x m/W at 24 deg C).

H. Glass-Fiber Board, Faced ASTM C612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84. Nominal density of 6 lb/cu. ft. (96 kg/cu. m), thermal resistivity of not less than 4.34 deg F x h x sq. ft./Btu x in. at 75 deg F (30.1 K x m/W at 24 deg C).

2.6 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

B. Mineral-Wool Blanket, Reinforced-Foil Faced ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.7 MINERAL-WOOL BOARD

A. Mineral-Wool Board, Types IA and IB, Unfaced ASTM C612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).

B. Mineral-Wool Board, Types IA and IB, Faced ASTM C612, Types IA and IB; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).

C. Mineral-Wool Board, Type II, Unfaced ASTM C612, Type II; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics. Nominal density of 6 lb/cu. ft. (96 kg/cu. m).

D. Mineral-Wool Board, Type II, Faced ASTM C612, Type II; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84. Nominal density of 6 lb/cu. ft. (96 kg/cu. m).

E. Mineral-Wool Board, Type III, Unfaced ASTM C612, Type III; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

F. Mineral-Wool Board, Type III, Faced ASTM C612, Type III; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E84. Nominal density of 8 lb/cu. ft. (128 kg/cu. m).

2.8 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm), 36 inches (915 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm), 36 inches (915 mm) in from exterior walls.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward exterior of construction, or interior of construction as directed.
    b. Interior Walls: Set units with facing placed as indicated on Drawings, toward areas of high humidity.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.
2. Open-cell spray polyurethane foam.

B. Related Requirements:

1. Section 075700 "Coated Foamed Roofing" for spray polyurethane foam insulation used for roofing applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (25 mm of 43 K x sq. m/W at 24 deg C).
1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25, 75 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 OPEN-CELL SPRAY POLYURETHANE FOAM

A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 3.4 deg F x h x sq. ft./Btu at 75 deg F (24 K x sq. m/W at 24 deg C).

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25, 75 or less.
    b. Smoke-Developed Index: 450 or less.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 072119

SECTION 072413 - POLYMER-BASED EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. EIFS-clad barrier-wall assemblies that are field applied over substrate.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each EIFS component, trim, and accessory.

B. Sustainable Design Submittals:

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer certificates.

B. Product certificates.

C. Product test reports.

D. Field quality-control reports.

E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five, 10, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E2568 and with the following:

1. Weathertightness: Resistant to water penetration from exterior.
2. Impact Performance: ASTM E2568, Standard, Medium, High, Ultra High, impact resistance unless otherwise indicated.

2.3 EIFS MATERIALS

A. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

B. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; compatible with substrate.

C. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E2430/E2430M.

1. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.

D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) according to ASTM E2098/E2098M.

1. Reinforcing Mesh for EIFS, General: Not less than weight required to comply with impact-performance level specified in "Performance Requirements" Article.

E. Base Coat: EIFS manufacturer's standard mixture.

F. Water-Resistant Base Coat: EIFS manufacturer's standard waterproof formulation.

G. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

H. Finish Coat: EIFS manufacturer's standard acrylic-based coating, standard acrylic-based coating with enhanced mildew resistance, siliconized acrylic-based coating, elastomeric coating.

1. Colors: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.
2. Textures: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

I. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784 and ASTM C1063.

PART 3 - EXECUTION

3.1 EIFS INSTALLATION

A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate.

B. Flexible-Membrane Flashing: Apply and lap to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.

C. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.

D. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C1397.

1. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch (0.8 mm) or 1/16 inch (1.6 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch (1.6 mm). Prevent airborne dispersal and immediately collect insulation raspings or sandings.
2. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and EIFS lamina.

E. Expansion Joints: Install at locations indicated and where required by EIFS manufacturer.

F. Water-Resistant Base Coat: Apply full-thickness coverage to exposed insulation and to exposed surfaces of sloped shapes, window sills, parapets, foam buildouts and to other surfaces indicated on Drawings.

G. Base Coat: Apply full coverage to exposed insulation and foam buildouts with not less than 1/16-inch (1.6-mm) dry-coat thickness.

H. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397. Do not lap reinforcing mesh within 8 inches (200 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

I. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397 in same manner as first application. Do not apply until first base coat has cured.

J. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.

K. Foam Buildouts: Fully embed reinforcing mesh in base coat.

L. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

M. Finish Coat: Apply full-thickness coverage over dry primed base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

N. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.2 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform.

B. Testing Agency: Owner will engage, Engage a qualified testing agency to perform tests and inspections.

C. EIFS Tests and Inspections: According to ASTM E2568.

D. EIFS will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 072413

SECTION 072419 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. EIFS-clad drainage-wall assemblies that are field applied over substrate.
2. Water-resistive barrier coatings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each EIFS component, trim, and accessory, including water-resistive barrier coatings.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Include details for EIFS buildouts.
2. Include details for parapet cap flashing.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer certificates.

B. Product certificates.

C. Product test reports.

D. Field quality-control reports.

E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five, 10, years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E2568 and with the following:

1. Weathertightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
2. Impact Performance: ASTM E2568, Standard, Medium, High, Ultra High impact resistance, unless otherwise indicated.
3. Drainage Efficiency: 90 percent average minimum when tested according to ASTM E2273.

2.3 EIFS MATERIALS

A. Water-Resistive Barrier Coating: EIFS manufacturer's standard formulation and accessories for use as water-resistive barrier coating; compatible with substrate.

1. Water-Resistance: Comply with physical and performance criteria of ASTM E2570/E2570M.

B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt, and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

C. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate.

D. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E2430/E2430M.

1. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.

E. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) according to ASTM E2098/E2098M.

F. Base Coat: EIFS manufacturer's standard mixture.

G. Water-Resistant Base Coat: EIFS manufacturer's standard water-resistant formulation.

H. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

I. Finish Coat: EIFS manufacturer's standard acrylic-based coating, standard acrylic-based coating with enhanced mildew resistance, siliconized acrylic-based coating, elastomeric coating.

1. Colors: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.
2. Textures: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range.

J. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784, manufacturer's standard cell class for use intended, and ASTM C1063.

PART 3 - EXECUTION

3.1 EIFS INSTALLATION

A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

B. Water-Resistive Barrier Coating: Apply over sheathing to provide a water-resistive barrier.

C. Flexible-Membrane Flashing: Install over water-resistive barrier coating, applied and lapped to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.

D. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.

E. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C1397.

1. Apply adhesive to insulation by notched-trowel method, with notches oriented vertically to produce drainage channels that remain functional after the insulation is adhered to substrate.
2. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch (0.8 mm), 1/16 inch (1.6 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch (1.6 mm). Prevent airborne dispersal and immediately collect insulation raspings or sandings.
3. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier coating.

F. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer.

G. Water-Resistant Base Coat: Apply full-thickness coverage to exposed insulation and to exposed surfaces of sloped shapes, window sills, parapets, foam build-outs and to other surfaces indicated on Drawings.

H. Base Coat: Apply full coverage to exposed insulation and foam build-outs with not less than 1/16-inch (1.6-mm), dry-coat thickness.

I. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397. Do not lap reinforcing mesh within 8 inches (200 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

J. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C1397 in same manner as first application. Do not apply until first base coat has cured.

K. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.

L. Foam Buildouts: Fully embed reinforcing mesh in base coat.

M. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

N. Finish Coat: Apply full-thickness coverage over dry primed base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

O. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.2 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform.

B. Testing Agency: Owner will engage, Engage a qualified testing agency to perform tests and inspections.

C. EIFS Tests and Inspections: According to ASTM E2359/E2359M.

D. EIFS will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 072419

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building paper.
2. Building wrap.
3. Flexible flashing.
4. Drainage material.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCT

2.1 WATER-RESISTIVE BARRIER

A. Building Paper: ASTM D226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D; except with water-resistance rating not less than 1 hour.

C. Building Wrap: ASTM E1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Water-Vapor Permeance: Not less than 75 perms (4300 ng/Pa x s x sq. m), 20 perms (1150 ng/Pa x s x sq. m), 8 perms (460 ng/Pa x s x sq. m) per ASTM E96/E96M, Desiccant Method (Procedure A).
2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm), 0.030 inch (0.8 mm), 0.040 inch (1.0 mm).
   1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm), 0.030 inch (0.8 mm), 0.040 inch (1.0 mm).
   1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.3 DRAINAGE MATERIAL

A. Drainage Material: Product shall maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane and shall be used under siding, portland cement plaster, adhered masonry veneer.
   1. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:

   1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.

C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
2. Lap flashing over water-resistive barrier at bottom and sides of openings.
3. Lap water-resistive barrier over flashing at heads of openings.

3.3 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D4397, as directed 6-mil- (0.15-mm-) or 10-mil- (0.25-mm-) thick sheet, with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

2.2 REINFORCED-POLYETHYLENE VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 20 lb/1000 sq. ft. (9 kg/100 sq. m), with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

PART 3 - EXECUTION

3.1 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES

A. Install vapor retarders over prepared grade. Lap joints a minimum of 12 inches (305 mm) and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.

B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.

1. Extend vapor retarder vertically minimum 16 inches (406 mm) or 24 inches (610 mm) above top of footing as directed.

C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

END OF SECTION 072600

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of modified bituminous sheet air barrier.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to

demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
b. Include junction with roofing membrane, building corner condition and foundation wall intersection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

2.2 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil (1.0-mm) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil (0.1-mm) thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Tensile Strength: Minimum 250 psi (1.7 MPa); ASTM D412, Die C.
c. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E154/E154M.
e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
f. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
g. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541 as modified by ABAA.

h. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
i. UV Resistance: Can be exposed to sunlight for 30 or 60 days according to manufacturer's written instructions.

B. Aluminum-Faced Modified Bituminous Sheet: 40-mil (1.0-mm) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil (0.1-mm) thick, cross-laminated polyethylene film faced with aluminum foil, with release liner on adhesive side[and formulated for application with primer that complies with VOC limits].

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Tensile Strength: Minimum 250 psi (1.7 MPa); ASTM D412, Die C.
c. Ultimate Elongation: Minimum 80 percent; ASTM D412, Die C.
d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E154/E154M.
e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
f. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
g. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541 as modified by ABAA.
h. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
i. UV Resistance: Can be exposed to sunlight for 360 days according to manufacturer's written instructions.

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by air-barrier material manufacturer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).
2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

D. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

E. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

G. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

H. Do not cover air barrier until it has been tested and inspected by testing agency.

I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers or ASTM E1186, chamber depressurization using detection liquids.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

END OF SECTION 072713

SECTION 072715 - NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-adhering, vapor-retarding, nonbituminous sheet air barriers.
2. Self-adhering, vapor-permeable, nonbituminous sheet air barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of nonbituminous self-adhering sheet air barrier.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

2.2 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Retarding Nonbituminous Sheet: Minimum 10-mil (0.25-mm) thick, self-adhering sheet consisting of 5 mils (0.13 mm) of air-barrier film and a 5-mil (0.13-mm) thick, acrylic adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

    a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
    b. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E154/E154M.
    c. Vapor Permeance: Maximum 1.0 perm (57.5 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
    d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541 as modified by ABAA.
    e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

f. UV Resistance: Can be exposed to sunlight for 150 days according to manufacturer's written instructions.

B. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil (0.5-mm) thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E154/E154M.
c. Vapor Permeance: Minimum 15 perms (860 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D4541 as modified by ABAA.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 50 or 150 days according to manufacturer's written instructions.

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by air-barrier material manufacturer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch (64-mm) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

D. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

E. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

G. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

H. Do not cover air barrier until it has been tested and inspected by testing agency.

I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers or ASTM E1186, chamber depressurization using detection liquids.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

END OF SECTION 072715

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vapor-retarding, fluid-applied air barriers.
2. Vapor-permeable, fluid-applied air barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier: Modified bituminous or synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Modified Bituminous Type: As directed.

2. Synthetic Polymer Type: As directed.

3. Physical and Performance Properties:

    a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
    b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
    c. Ultimate Elongation: Minimum 500 percent; ASTM D412, Die C.

d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 30, 90 or 180 days according to manufacturer's written instructions.

2.4 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. High-Build, Vapor-Permeable Air Barrier: Modified bituminous or synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Modified Bituminous Type: As directed.

2. Synthetic Polymer Type: As directed.

3. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 30, 90 or 180 days according to manufacturer's written instructions.

2.5 MEDIUM-BUILD AIR BARRIERS, VAPOR RETARDING

A. Medium-Build, Vapor-Retarding Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils (0.4 to 0.8 mm) over smooth, void-free substrates.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m) or 5.7 perms (327 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
c. Ultimate Elongation: Minimum 350 percent; ASTM D412, Die C.

d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 90 or 180 days according to manufacturer's written instructions.

2.6 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 17 to 30 mils (0.4 to 0.8 mm) over smooth, void-free substrates.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 180 or 360 days according to manufacturer's written instructions.

2.7 LOW-BUILD AIR BARRIERS, VAPOR RETARDING

A. Low-Build, Vapor-Retarding Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils (1.5 to 0.38 mm) over smooth, void-free substrates.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m) or 5.7 perms (327 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method.
c. Ultimate Elongation: Minimum 350 percent; ASTM D412, Die C.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.

e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 90 or 180 days according to manufacturer's written instructions.

2.8 LOW-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. Low-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils (1.5 to 0.38 mm) over smooth, void-free substrates.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E2178.
b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M, Desiccant Method, Procedure A.
c. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) or 30 lbf/sq. in. (207 kPa) when tested according to ASTM D4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 180 or 360 days according to manufacturer's written instructions.

2.9 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

D. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils (0.9 mm), not less than 40 mils (1.0 mm) or not less than 45 mils (1.1 mm), applied in one coat or two equal coats or one or more equal coats.
2. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils (0.9 mm), applied in one coat, two equal coats or one or more equal coats.

F. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, not less than 17 mils (0.4 mm) or not less than 30 mils (0.8 mm), applied in one coat, two equal coats or one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface.
2. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one coat, two equal coats or one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

G. Low-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, not less than 15 mils (0.38 mm) or not less than 6 mils (1.5 mm), applied in one coat, two equal coats or one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface.
2. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one coat, two equal coats or one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.

H. Do not cover air barrier until it has been tested and inspected by testing agency.

I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Tests: As determined by testing agency from among the following tests:

1. Air-barrier dry film thickness.
2. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers or ASTM E1186, chamber depressurization using detection liquids.
3. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
4. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Remove masking materials after installation.

END OF SECTION 072726

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Underlayment.
3. Ridge vents.
4. Metal flashing and trim.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for ridge vents.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Evaluation reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Material Warranty Period: 25, 30, 35, 40 or 50 years from date of Substantial Completion, prorated, with first three, five, seven, 10, 15 or 20 years nonprorated, as directed
2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 60 mph (27 m/s), 70 mph (31 m/s), 80 mph (36 m/s), 100 mph (45 m/s), 110 mph (49 m/s), 130 mph (58 m/s) or 135 mph (60 m/s) for five or 15 years from date of Substantial Completion, as directed.
3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for five, 10, 15 or 20 years from date of Substantial Completion.
4. Workmanship Warranty Period: Two, 20 or 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratories, Inc. or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Butt Edge: Straight, Notched or Crenelated cut.
2. Strip Size: Manufacturer's standard.
3. Algae Resistance: Granules resist algae discoloration.
4. Impact Resistance: UL 2218, Class 4.
5. Color and Blends: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

B. Three-Tab-Strip Asphalt Shingles: ASTM D3462/D3462M, glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.

1. Strip Size: Manufacturer's standard.
2. Algae Resistance: Granules resist algae discoloration.
3. Impact Resistance: UL 2218, Class 4.
4. Color and Blends: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

C. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles or Site-fabricated units cut from asphalt-shingle strips. Trim each side of lapped portion of unit to taper approximately 1 inch (25 mm).

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M or ASTM D4869/D4869M, asphalt-saturated organic felts, nonperforated.

1. Type: Type I or Type II.

B. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D1970/D1970M, minimum of 55-mil (1.4-mm), 50-mil (1.3-mm) or 40-mil (1.0-mm) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

D. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D1970/D1970M, minimum of 40-mil (1.0-mm) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to

SBS-modified asphalt adhesive, with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

E. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40-mil (1.0-mm) thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C) according to ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C) according to ASTM D1970/D1970M.

2.4 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge shingles.

1. Minimum Net Free Area: As directed.
2. Width: As directed.
3. Thickness: As directed.
4. Features:

    a. Nonwoven geotextile filter strips.
    b. External deflector baffles.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586, Type II, asbestos free.

B. Roofing Nails: ASTM F1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.

1. Shank: Barbed or Smooth.
2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

D. Synthetic-Underlayment Fasteners: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

2.6 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Copper, Stainless steel, Zinc-tin alloy-coated stainless steel, Zinc-tin alloy-coated steel, Zinc-tin alloy-coated copper, Anodized aluminum or Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (50 mm) over underlying course. Lap ends a minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with felt-underlayment or roofing nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (75 mm) in direction that sheds water. Lap ends of felt not less than 6 inches (150 mm) over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inches (914 mm) o.c.

C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a 19-inch- (485-mm-) wide starter course at eaves and completely cover with full-width second course. Install succeeding courses lapping previous courses 19 inches (485 mm) in shingle fashion. Lap ends a minimum of 6 inches (150 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm) fasten with felt-underlayment or roofing nails.

1. Apply a continuous layer of asphalt roofing cement over starter course and on felt-underlayment surface to be concealed by succeeding courses as each felt course is installed. Apply over entire roof or at locations indicated on Drawings.
2. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches (75 mm) in direction that sheds water.

3. Terminate felt underlayment flush or extended up not less than 4 inches (100 mm) against sidewalls, curbs, chimneys, and other roof projections.
4. Install fasteners at no more than 36 inch (914 mm) o.c.

D. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.

1. Install in single layer on roofs sloped at 4:12 and greater.
2. Install in double layer on roofs sloped at less than 4:12.

E. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

3.3 ASPHALT-SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip with tabs removed at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 1/2 inch (13 mm) or 3/4 inch (19 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with 4-inch (100-mm), 5-inch (125-mm) or 6-inch (150-mm) half-tab, one-third-tab or manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

F. Fasten asphalt-shingle strips with a minimum of four, five or six roofing nails located according to manufacturer's written instructions.

1. Where roof slope exceeds 21:12, seal asphalt shingles with asphalt roofing cement spots after fastening with additional roofing nails.
2. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
3. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.

G. Woven Valleys: Extend succeeding asphalt-shingle courses from both sides of valley 12 inches (300 mm) beyond center of valley, weaving intersecting shingle-strip courses over each other. Use one-piece shingle strips without joints in valley.

1. Do not nail asphalt shingles within 6 inches (150 mm) of valley center.

H. Closed-Cut Valleys: Extend asphalt-shingle strips from one side of valley 12 inches (300 mm) beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt-shingle courses from other side of valley and cut back to a straight line 2 inches (50 mm) short of valley centerline. Trim upper concealed corners of cut-back shingle strips.

1. Do not nail asphalt shingles within 6 inches (150 mm) of valley center.
2. Set trimmed, concealed-corner asphalt shingles in a 3-inch (75-mm) wide bed of asphalt roofing cement.

I. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips. Maintain uniform width of exposed open valley or Widen exposed portion of open valley 1/8 inch in 12 inches (1:96)] from highest to lowest point.

1. Set valley edge of asphalt shingles in a 3-inch (75-mm) wide bed of asphalt roofing cement.
2. Do not nail asphalt shingles to metal open-valley flashings.

J. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

K. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 073113

SECTION 073116 - METAL SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal-shingle panels.
2. Individual metal shingles.
3. Underlayment.
4. Accessory metal flashing and trim.
5. Ridge vents.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For metal shingles. Include roof plans; sections at hips, gables, ridges, valleys, and eaves; details of metal shingles, flashing, trim, and accessories; and attachments to other work.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace metal shingles and accessories that fail in materials within specified warranty period.

1. Materials-Only Warranty Period: 15, 25 or 50 years from date of Substantial Completion, as directed.

B. Special Project Warranty: Roofing Installer's Warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, in which Installer agrees to repair or replace components of roofing that fail in materials or workmanship within the following warranty period:

1. Warranty Period: Two or Five years from date of Substantial Completion.

C. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace metal shingles that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 10 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test Exposure Rating: Class A as acceptable to authorities having jurisdiction.

B. Wind-Uplift Resistance: Provide metal-shingle assemblies that comply with the following wind-uplift requirements:

1. Class: 15, 30, 60 or 90 when tested according to UL 580.
2. Uplift Resistance: 75 lbf/sq. ft. (3.6 kPa), 120 lbf/sq. ft. (5.75 kPa) or 165 lbf/sq. ft. (7.9 kPa) when tested according to UL 1897.

C. Impact Resistance: Class 3 or Class 4 when tested according to UL 2218.

D. Energy Performance, ENERGY STAR: Provide roofing system that is listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

2.2 METAL SHINGLES

A. Aluminum Shingles: Factory-formed, interlocking shingle panels or individual shingles.

1. Shingle Panels: Stamped panels resembling multiple shakes, shingles, Spanish tiles, flat tiles or scalloped tiles.

a. Material: Formed aluminum, 0.020 inch (0.51 mm) thick, 0.032 inch (0.81 mm) thick or thickness as needed to comply with performance requirements.
b. Exposure: 48 by 12 inches (1219 by 305 mm).

c. Finish: Mill or High-performance organic coating.
d. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

2. Individual Shingles: Rectangular or Diamond shingle units.

a. Material: Formed aluminum, 0.020 inch (0.51 mm) thick, 0.032 inch (0.81 mm) thick or thickness as needed to comply with performance requirements.
b. Exposure: 14 by 14 inches (356 by 356 mm).
c. Finish: Mill or High-performance organic coating.
d. Color: As indicated by manufacturer's designations, Match Architect's samples, as selected by Architect from manufacturer's full range.

B. Steel Shingles: Factory-formed, interlocking shingle panels or individual shingles.

1. Shingle Panels: Stamped panels resembling multiple shakes, shingles, Spanish tiles, flat tiles or scalloped tiles.

a. Material: Aluminum-zinc alloy-coated or Zinc-coated (galvanized) steel sheet, nominal 0.022 inch (0.56 mm) thick, 0.028 inch (0.71 mm) thick or thickness as needed to comply with performance requirements.
b. Exposure: 47-1/4 by 15-13/16 inches (1200 by 402 mm).
c. Finish: Mill, Granular coating or High-performance organic coating.
d. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

2. Individual Shingles: Rectangular shingle units.

a. Material: Aluminum-zinc alloy coated or Zinc-coated (galvanized)] steel sheet, nominal 0.022 inch (0.56 mm) thick, 0.028 inch (0.71 mm) thick or thickness as needed to meet performance requirements.
b. Exposure: 9 by 12 inches (229 by 305 mm).
c. Finish: Mill, Granular coating or High-performance organic coating.
d. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

C. Copper Shingles: Factory-formed, interlocking shingle panels or individual shingles.

1. Shingle Panels: Stamped panels resembling multiple shakes or shingles.

a. Material: Copper sheet, 12 oz./sq. ft. (0.41 mm thick), 16 oz./sq. ft. (0.55 mm thick) or weight (thickness) as needed to comply with performance requirements.
b. Exposure: 33-1/4 by 10 inches (845 by 254 mm).
c. Finish: Mill, Pre-patinated dark brown or Pre-patinated verdigris.

2. Individual Shingles: Rectangular or Diamond shingle units.

a. Material: Copper sheet, 12 oz./sq. ft. (0.41 mm thick), 16 oz./sq. ft. (0.55 mm thick) or weight (thickness) as needed to comply with performance requirements.
b. Exposure: 9-1/2 by 7-1/4 inches (241 by 184 mm).
c. Finish: Mill, Pre-patinated dark brown or Pre-patinated verdigris.

2.3 SHEET METAL MATERIALS

A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: Uncoated aluminum sheet.
2. High-Performance Organic Coating (Coil-Coated Finishes): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, Class AZ50 coating designation, Grade 37 (Class AZM150 coating designation, Grade 255); structural quality.

1. Granular-Coating Finish: Entire upper surface of shingle, including flange edges, coated with ceramic-colored quartz granules or crushed stone chips bonded to shingle with a resin adhesive and sealed with a clear overglaze.

C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation; structural quality.

1. High-Performance Organic Coating (Coil-Coated Finishes): Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

D. Copper Sheet: ASTM B370; Temper H00, cold rolled unless Temper 060 is required for forming.

1. Mill Finish: Nonpatinated and exposed.
2. Pre-Patinated Finish: Dark brown or Verdigris, pre-patinated according to ASTM B882.

2.4 UNDERLAYMENT

A. Felt Underlayment: ASTM D226/D226M or ASTM D4869/D4869M, Type I or Type II, asphalt-saturated organic felt, nonperforated.

B. Felt Underlayment, High Wind: ASTM D226/D226M, Type II or ASTM D4869/D4869M, Type IV, asphalt-saturated organic felt, nonperforated.

C. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40 mils (1.0 mm) thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C) according to ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C) according to ASTM D1970/D1970M.

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.5 ACCESSORIES

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other accessory items as required for a complete roofing system and as recommended by metal-shingle manufacturer unless otherwise indicated.

B. Sheet Metal Flashing and Trim: Metal-shingle manufacturer's flashing and trim components matching shingle material, color, and finish unless otherwise indicated or recommended in writing by metal-shingle manufacturer. Fabricate to sizes and configurations shown or required. Unless otherwise indicated, fabricate sheet metal flashing and trim to comply with recommendations that apply to design, dimensions, metal, and other characteristics of the item in SMACNA's "Architectural Sheet Metal Manual."

C. Ridge Vents: Metal-shingle manufacturer's continuous vented ridge caps matching material and finish of metal shingles with insect screen or insect-resisting geotextile filter strips and with external deflector baffles; for use with specified metal shingles.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586, Type II, asbestos free.

F. Sealant: ASTM C920, one-part elastomeric polymer joint sealant as recommended by metal-shingle manufacturer for installation indicated; of Type, Grade, Class, and Use classifications

required to seal joints in metal shingles and remain watertight. Where sealant is exposed, provide in color matching shingle.

G. Sheet Metal Fasteners: Noncorrosive screws, nails, and anchors designed to withstand design loads as recommended in writing by metal-shingle manufacturer.

1. Exposed Fasteners: Heads matching color of metal shingles using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC washers under heads of exposed fasteners bearing on weather side of shingles.

H. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter. Capped heads or disc caps shall be minimum 0.134-inch- (0.34-mm) thick metal, and nail shank shall be at least 0.105 inch (2.67 mm) thick, with a length to penetrate through at least 0.75 inch (19.1 mm) into the roof sheathing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking, that tops of fasteners are flush with surface, and that installation is within flatness tolerances.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with metal-shingle and underlayment manufacturers' written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with felt underlayment nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 4 inches (102 mm) in direction to shed water. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet underlayment.
2. Install fasteners along overlap at no more than 36 inches (914 mm) o.c. or in a grid pattern of 6 inch (152 mm) spacing alongside laps and 12 inch (305 mm) spacing between side laps.]

C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a 19-inch (485-mm) wide starter course at eaves and completely cover with full-width second course. Install succeeding courses lapping previous courses 19 inches (485 mm) in

shingle fashion. Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with felt underlayment nails.

1. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 4 inches (102 mm) in direction to shed water.
2. Terminate felt underlayment flush or extended up not less than 4 inches (102 mm)] against sidewalls, curbs, chimneys, and other roof projections.
3. Install fasteners along overlap at no more than 36 inches (914 mm) o.c. or in a grid pattern of 6 inch (152 mm) spacing alongside laps and 12-inch (305 mm) spacing between side laps.

D. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer. Install lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

E. Apply slip sheet with adhesive or tape before installing metal flashing and shingles.

3.3 METAL-SHINGLE INSTALLATION

A. General: Install underlayment and metal shingles according to manufacturer's written instructions applicable to products and applications indicated; install level, plumb, and true to line.

B. Maintain uniform exposure and coursing of metal shingles throughout roof.

C. Apply sealant between shingles, flashing, trim, and exposed fasteners to achieve a weathertight system.

D. Interlock and overlap shingles, and stagger end joints from or align joints of tile-form shingle courses above and below.

E. Metal Protection: Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by manufacturer of metal shingles or of the metals in contact.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories according to manufacturers' written instructions unless more stringent requirements are indicated.

B. Metal Flashings and Trim: Install metal flashings and trim according to recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.

C. Metal Protection: Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended by manufacturer of metal shingles or of the metals in contact.

3.5 ADJUSTING

A. Remove temporary protective coverings and strippable films as metal shingles are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of installation, clean exposed surfaces of metal shingles and touch up minor nicks and abrasions in finish, according to manufacturer's written instructions. Remove excess sealants.

END OF SECTION 073116

SECTION 073126 - SLATE SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slate shingles.
2. Underlayment.
3. Ridge vents.
4. Flashing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports for slate.

B. Evaluation reports for synthetic underlayment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide slate shingles and related roofing materials identical to those of assemblies tested for Class A, Class B or Class C fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratories Inc. or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 SLATE SHINGLES

A. Slate Shingles: ASTM C406/C406M, Grade S1 or Grade S2; hard, dense, and sound; with chamfered edges and nail holes machine punched or drilled and countersunk; with no broken or cracked slates, no broken exposed corners, and no broken corners on covered ends that could sacrifice nailing strength or laying of a watertight roof.

1. Thickness and Surface Texture: Nominal 1/4 inch (6 mm), smooth, 1/4 to 3/8 inch (6 to 10 mm), rough or 3/8 to 1/2 inch (10 to 13 mm), rough.
2. Length: 16 inches (406 mm), 18 inches (457 mm) or 20 inches (508 mm).
3. Width: 14 inches (356 mm), 12 inches (305 mm), 11 inches (279 mm), 10 inches (254 mm), 9 inches (229 mm), 8 inches (203 mm) or random widths, but not less than one-half-length.
4. Nail Holes: Two or Four per shingle, as directed.
5. Butt Shape: Standard square cut, Pointed, Deep bevel, Shallow bevel, Deep scallop, Shallow scallop or Round.
6. Color: Black, Gray, Purple, Green, Blue black, Blue gray, Mottled purple and green, Red, match Architect's samples or as selected by Architect from manufacturer's full range.
7. Weather-Exposure Color Change: Unfading, Weathering or as directed.

B. Starter Slate: Slate shingles with chamfered nail holes front-side punched.

1. Length: Exposure of slate shingle plus head lap.

C. Ridge Slate: Slate shingles fabricated with vertical or horizontal grain orientation.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type I, ASTM D226/D226M, Type II, ASTM D4869/D4869M, Type III or ASTM D4869/D4869M, Type IV, asphalt-saturated organic felt, nonperforated.

B. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D1970/D1970M, minimum of 55-mil (1.4 mm), 50-mil (1.3 mm) or 40-mil (1.0 mm) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

D. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D1970/D1970M, minimum of 40-mil (1.0 mm) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

2.4 RIDGE VENTS

A. Rigid-Plastic Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under slate ridge shingles.

1. Minimum Net Free Area: As directed.
2. Width: As directed.
3. Thickness: As directed.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M, Type II, asbestos free.

B. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in slate-shingle roofing and remain watertight.

D. Slating Nails: ASTM F1667, copper, stainless-steel, bronze or cut-brass, smooth-shanked, wire nails; 0.135 inch (3.4 mm) minimum thickness; sharp pointed; with 3/8 inch (10 mm) minimum diameter flat head; of sufficient length to penetrate a minimum of 3/4 inch (19 mm) into sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

E. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1 inch (25 mm) minimum diameter.

1. Provide cap nails complying with written recommendations of synthetic-underlayment manufacturer.
2. Provide with minimum 0.0134 inch (0.34 mm) thick cap, and with minimum 0.105-inch-(2.67 mm) thick shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing.

F. Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry." Section 061053 "Miscellaneous Rough Carpentry."

2.6 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Copper, Stainless steel, Zinc-tin alloy-coated stainless steel, Zinc-tin alloy-coated steel, Zinc-tin alloy-coated copper, Anodized aluminum or Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for design, dimensions, metal, and other characteristics of the item.

C. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch (1.6 mm) thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 4 inches (102 mm) from pipe onto roof.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) in direction that sheds water. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6-inch (152 mm) spacing at side laps.

C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a 19 inch (483 mm) wide starter course at eaves and completely cover with a 36 inch (914 mm) wide second course. Install succeeding 36 inch (914 mm) wide courses lapping previous courses 19 inches (483 mm) in shingle fashion. Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c., except 6 inches (152 mm) spacing at the side laps.
2. Apply a continuous layer of asphalt roofing cement over starter course and on felt underlayment surface to be concealed by succeeding courses as each felt course is installed. Apply over entire roof or at locations indicated on Drawings.
3. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) where overlap is in direction that sheds water.

4. Terminate felt underlayment flush or extended up not less than 4 inches (100 mm) against sidewalls, curbs, chimneys, and other roof projections.

D. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer but not less than 2 inches (51 mm) or 4 inches (102 mm) for side laps and 8 inches (203 mm) for end laps. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten with underlayment nails according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.

1. Install in double layer on roofs sloped from 4:12 to 20:12.
2. Install in single layer on roofs sloped at greater than 20:12.
3. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inches (152 mm) spacing at side laps.

E. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

F. Valley Underlayment: Install two layers of 36 inch (914mm) wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches (1829 mm). Lap ends of each layer at least 12 inches (305 mm) in direction that sheds water, and seal with asphalt roofing cement. Fasten each layer to roof deck with underlayment nails.

1. Lap roof-deck underlayment over first layer of valley underlayment at least 6 inches (152 mm).

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in NRCA's "NRCA Roofing and Waterproofing Manual."

B. Pipe Flashings: Form flashing around pipe penetrations and slate shingles. Fasten and seal to slate shingles.

3.3 SLATE-SHINGLE INSTALLATION

A. General: Beginning at eaves, install slate shingles according to manufacturer's written instructions and to details and recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems."

1. Install wood strip cant at eave edges under underlayment.
2. Install shingle starter course chamfered face down.

B. Install first and succeeding shingle courses chamfered face up. Install full-width first course at rake edge.

1. Offset joints of uniform-width slate shingles by half the shingle width in succeeding courses.
2. Offset joints of random-width slate shingles a minimum of 3 inches (76 mm) in succeeding courses.

C. Maintain a 4 inch (102 mm) or 3 inch (76 mm) minimum head lap between succeeding shingle courses.

D. Maintain uniform exposure of shingle courses between eaves and ridge or midway between eaves and ridge, and increase head lap of succeeding shingle courses to ensure uniform exposure on remaining shingle courses].

E. Extend shingle starter course and first course 1 inch (25 mm) or inches (51 mm)] over fasciae at eaves.

F. Extend shingle starter course and succeeding courses 1 inch (25 mm) over fasciae at rakes.

G. Cut and fit slate neatly around roof vents, pipes, ventilators, and other projections through roof.

H. Hang slate with two or four slating nails for each shingle with nail heads lightly touching slate. Do not drive nails home, which draws slates downward, and do not leave nail heads protruding enough to interfere with the overlapping shingle above.

1. At vented ridges, terminate slate shingles to produce a uniform air space on each side of ridge apex.

I. Ridges: Install ridge slate in saddle, strip saddle or combed configuration.

1. Install and anchor wood nailer strips of thicknesses to match abutting courses of slate shingles, terminating nailer strip 3 to 4 inches (76 to 102 mm) from the eave. Cover with underlayment strip, extending to underlying slate but concealed by ridge slate.
2. Lay ridge slate in bed of asphalt roofing cement or butyl sealant.
3. Anchor ridge slate to supporting wood nailer strip with two or four nails for each slate shingle without nails penetrating underlying slate.
4. Extend combed-ridge slate over leeward ridge slate by 1/8 to 1/4 inch (3 to 6 mm). Seal ridge joint with elastomeric sealant.

5. Cover heads of exposed nails at final ridge shingle with asphalt roofing cement or butyl sealant.

J. Hips: Install and anchor slate hips in saddle, mitered or fantail configuration.

1. Install and anchor wood nailer strips of thickness to match abutting courses of slate shingles. Cover nailer strip with underlayment strip, extending on to underlying slate but concealed by hip slate. Anchor hip slate to nailer strip with two nails located in upper third of hip-slate length.
2. Notch starter shingle and first shingle course at hip to fit around nailer strips so no wood is exposed at ridge eave.
3. Lay hip slate in bed of asphalt roofing cement or butyl sealant.
4. Seal hip centerline joint with elastomeric sealant.

K. Open Valleys: Cut slate shingles to form straight lines at open valleys, trimming upper concealed corners of shingles. Maintain uniform width of exposed open valley or Widen exposed portion of open valley 1/8 inch in 12 inches (1:96) from highest to lowest point.

1. Do not nail shingles to valley metal flashings.

L. Closed Valleys: Cut slate shingles to form straight lines at closed valleys, trimming upper concealed corners of shingles. Maintain uniform gap at centerline of valley of 1/2 to 3/4 inch (13 to 19 mm) or 3/4 to 1 inch (19 to 25 mm).

1. Do not nail shingles to valley metal flashings.

3.4 RIDGE VENT INSTALLATION

A. Rigid-Plastic Ridge Vents: Install continuous ridge vents according to manufacturer's written instructions. Fasten with slating nails of sufficient length to penetrate sheathing.

END OF SECTION 073126

SECTION 073129 - WOOD SHINGLES AND SHAKES.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof shingles.
2. Wood roof shakes.
3. Underlayment.
4. Ridge vents.
5. Metal flashing and trim.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. As directed.

B. Installer Qualifications: Approved by CSSB.

C. Grading Agency Qualifications: An independent testing and inspecting agency recognized by authorities having jurisdiction as qualified to label wood products for compliance with referenced grading rules.

1.7 WARRANTY

A. Special Materials Warranty: Manufacturer's warranty administered by CSSB and on CSSB's standard form in which the Manufacturer agrees to repair or replace CSSB-labeled products that fail in materials within specified warranty period. Material failures include manufacturing defects that result in leaks.

1. Materials Warranty Period: Limited lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide roofing materials identical to those of assemblies tested for fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Wood Products: Class B or Class C.

a. Fire-Retardant Treatment: Exterior-type pressure treatment complying with AWPA U1.
b. Accelerated Weathering: Subject test specimens to ASTM D2898 Method A before testing.
c. Identification: Attach a label to each bundle of wood products; include identification mark of testing agency acceptable to authorities having jurisdiction and identify manufacturer, chemical treatment, method of application, purpose of treatment, and warranties available.

B. Decay Resistance: Provide wood products treated according to AWPA U1, chromated copper arsenate (CCA) pressure treatment; with a minimum of 0.40 lb/cu. ft. (6.4 kg/cu. m) retention.

1. Identification: Attach a label to each bundle of wood products; identify manufacturer, chemical treatment, method of application, purpose of treatment, and warranties available.

C. Grading Rules: Provide wood products that comply with Cedar Shake & Shingle Bureau's (CSSB) grading rules for products indicated.

1. Identification: Attach a label to each bundle of wood products that identifies manufacturer, type of product, grade, dimensions, and identification mark of grading agency acceptable to authorities having jurisdiction.

2.2 ROOF SHINGLES

A. Cedar Shingles: Smooth-sawn western red cedar shingles.

1. Grade: No. 1, with starter courses of No. 1, No. 2 or No. 3.
2. Size: 16 inches (406 mm) long; 0.40 inch (10 mm) thick, 18 inches (457 mm) long; 0.45 inch (11 mm) thick or 24 inches (610 mm) long; 0.50 inch (13 mm) thick at butt.

B. Cedar Ridge Units: Manufactured or Site-fabricated, smooth-sawn western red cedar caps for ridges and hips of same thickness as shingles, 7 inches (179 mm) wide; beveled, alternately overlapped, and nailed.

1. Grade: No. 1.
2. Length: 16 inches (406 mm) or 18 inches (457 mm).

C. Fancy-Butt Cedar Shingles: Clear heartwood red cedar, No. 1 grade, with butt shape indicated.

1. Butt Shape: Diagonal, Half Cove, Diamond, Round, Hexagonal, Octagonal, Arrow, Square or Fish Scale.
2. Size: 16 inches (406 mm) or 18 inches (457 mm)] long by 5 inches (127 mm) wide, in manufacturer's standard thickness.

2.3 ROOF SHAKES

A. Split Cedar Shakes: Hand-split and resawn western red cedar shakes; split face and sawn back.

1. Grade:

a. Roof: Premium or No. 1.
b. Starter Courses: Premium or No. 1.

2. Length: 18 inches (457 mm) or 24 inches (610 mm) with 15 inch (381 mm) long starter course.
3. Thickness: 1/2 inch (13 mm) or 3/4 inch (19 mm) at butt.

B. Taper-Sawn Cedar Shakes: Western red cedar shakes; sawn both sides.

1. Grade:

a. Roof: Premium or No. 1.
b. Starter Courses: Premium or No. 1.

2. Length: 18 inches (457 mm) or 24 inches (610 mm), with 15 inch (381 mm) long starter course.
3. Thickness: 5/8 inch (16 mm) or 3/4 inch (19 mm) at butt.

C. Cedar Ridge Units: Manufactured or Site-fabricated, western red cedar caps for ridges and hips of same type and grade as exposed roof shakes, 9 inches (229 mm) wide; beveled, alternately overlapped, and nailed.

1. Length: 18 inches (457 mm) or 24 inches (610 mm).
2. Thickness: 5/8 inch (16 mm) or 3/4 inch (19 mm) at butt.

2.4 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type I, ASTM D226/D226M, Type II, ASTM D4869/D4869M, Type III or ASTM D4869/D4869M, Type IV, asphalt-saturated organic felts, nonperforated.

1. Use as underlayment and shake interlayment.

B. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D1970/D1970M, minimum of 55 mil (1.4 mm), 50 mil (1.3 mm) or 40 mil (1.0-mm) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

C. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D1970/D1970M, minimum of 40 mil (1.0 mm) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

2.5 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge shingles.

1. Minimum Net Free Area: As directed.
2. Width: As directed.
3. Thickness: As directed.
4. Features:

    a. Nonwoven geotextile filter strips.
    b. External deflector baffles.

B. Flexible Ridge Vent: Manufacturer's standard, compression-resisting, three-dimensional, open-nylon or polyester-mat filter bonded to a nonwoven, nonwicking, geotextile fabric cover.

1. Minimum Net Free Area: As directed.
2. Width: As directed.
3. Thickness: As directed.

2.6 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586, Type II, asbestos free.

B. Drainage Mat: Manufacturer's standard, compression-resisting, three-dimensional, nonwoven, entangled filament, nylon mat designed to permit air movement and to drain incidental moisture by gravity.

C. Roofing Nails: ASTM F1667, stainless-steel, Type 304 or stainless-steel, Type 316 or hot-dip galvanized-steel box-type wire nails, sharp pointed, and of sufficient length to penetrate a minimum of 3/4 inch (19 mm) into sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Roofing Staples: Type 304 or Type 316, stainless-steel staples, 0.05 inch (1.3 mm) thick, with a minimum of 7/16 inch (11mm) crown width, of sufficient length to penetrate a minimum of 3/4 inch (19 mm) into sheathing.

E. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire nails; with 1 inch (25 mm) minimum diameter, low-profile capped heads or disc caps.

1. Provide with minimum 0.0134 inch (0.34 mm) thick cap and with minimum 0.105 inch (2.67mm) thick shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing.

2.7 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Copper, Stainless steel, Zinc-tin alloy-coated stainless steel, Zinc-tin alloy-coated steel, Zinc-tin alloy-coated copper, Anodized aluminum or Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Felt Underlayment: Fasten in a single layer with felt-underlayment nails.

1. Spaced Sheathing: Install on and parallel to solid-board portion of roof deck as eave protection. Install parallel to valleys. Lap ends a minimum of 4 inches (102 mm). Extend from edges of eaves 24 inches (610 mm) or 36 inches (914 mm) beyond interior face of exterior wall.

a. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) if more than one course is required, and stagger end laps between succeeding courses at least 72 inches (1829 mm).

2. Solid Sheathing: Install underlayment on entire area of roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm).

a. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (76 mm) in direction that sheds water. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet underlayment.

3. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152mm) spacing at side laps.

C. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

D. Metal-Flashed, Open-Valley Underlayment: Install 36 inch (914 mm) wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches (1829 mm). Lap ends of each layer at least 12 inches (305 mm) in direction that sheds water, and seal with asphalt roofing cement. Fasten to roof deck with felt-underlayment nails.

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations for wood roofing in NRCA's "NRCA Roofing and Waterproofing Manual."

3.3 ROOF-SHINGLE INSTALLATION

A. General: Install wood-shingle roofing according to manufacturer's written instructions and to recommendations in CSSB's "New Roof Construction Manual" and NRCA's "NRCA Roofing Manual: Steep-Slope Roofing Systems."

B. Install drainage mat perpendicular to roof slope in parallel courses, butting edges and ends to form a continuous layer, and fasten to roof deck.

C. Cedar Shingles: Maintain weather exposure of 5 inches (127 mm) for 16 inch (406 mm), 5-1/2 inches (140 mm) for 18 inch (457 mm) or 7-1/2 inches (191 mm) for 24 inch (610 mm) long shingles.

D. Open Valleys: Cut and fit wood shingles at open valleys, trimming upper concealed corners of shingles. Maintain uniform width of exposed open valley or Widen exposed portion of open valley 1/8 inch in 12 inches (1:96) from highest to lowest point.

E. Fancy-Butt Shingles: Maintain weather exposure of 5 inches (127 mm).

F. Ridge Vents: Install continuous ridge vents over wood shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate roof sheathing.

G. Ridge Units:

1. At unventilated ridges and hips, install concealed strip of felt or self-adhering sheet underlayment over apex shingles and below ridge units.
2. Fasten ridge units to cover ridge vent without obstructing airflow.

3.4 ROOF-SHAKE INSTALLATION

A. General: Install wood-shake roofing according to manufacturer's written instructions and to recommendations in CSSB's "New Roof Construction Manual" and NRCA's "NRCA Roofing Manual: Steep-Slope Roofing Systems."

B. Install drainage mat perpendicular to roof slope in parallel courses, butting edges and ends to form a continuous layer, and fasten to roof deck.

C. Interlayment: Interlay 18inch (457 mm) wide strip of felt over top portion of first and each succeeding course of shakes. Set bottom edge of felt interlayment at a distance of twice the weather-exposure dimension above the shake butt. Stagger fasten to roof deck with felt-underlayment nails.

D. Cedar Shakes: Maintain weather exposure of 5-1/2 inches (140 mm) for 18 inch (457 mm), 7-1/2 inches (191 mm) for 18 inch (457 mm), 7-1/2 inches (191 mm) for 24 inch (610 mm) or 10 inches (254 mm) for 24 inch (610 mm) long shakes.

E. Open Valleys: Cut and fit wood shakes at open valleys, trimming upper concealed corners of shakes. Maintain uniform width of exposed open valley or Widen exposed portion of open valley 1/8 inch in 12 inches (1:96) from highest to lowest point.

F. Ridge Vents: Install continuous ridge vents over wood shakes according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

G. Ridge Units:

1. At unventilated ridges and hips, install concealed strip of felt or self-adhering sheet underlayment over apex shingles and below ridge units.
2. Fasten ridge units to cover ridge vent without obstructing airflow.

END OF SECTION 073129

SECTION 073213 - CLAY ROOF TILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay roof tiles.
2. Underlayment.
3. Ridge vents.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As required.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports for clay roof tiles.

B. Evaluation reports for the following:

1. Clay roof tiles, fasteners, and attachment systems.
2. Synthetic underlayment.
3. High-temperature self-adhering underlayment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide clay roof tiles and related roofing materials identical to those of assemblies tested for Class A, Class B or Class C fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratories, Inc. or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 CLAY ROOF TILES

A. Clay Roof Tiles: ASTM C1167, molded- or extruded-clay roof tile units of shape and configuration indicated, kiln fired, and free of surface imperfections. Provide with fastening holes prepunched at factory before firing.

1. Durability: Grade 1, Grade 2 or Grade 3.
2. High-Profile Shape: Type I, Spanish or "S", tapered mission, two piece; straight mission, two piece; straight barrel mission, two piece; Greek, two piece or Roman, two piece.
    a. Accessory Tiles: Ridge, ridge vent, ridge end, hip and hip starter, header course, L-shaped rake edge, roll rake edge, starter, end band, terminal, eave closure and top fixture units.
3. Low-Profile Shape: Type II, French interlocking.
    a. Accessory Tiles: Ridge, ridge vent, ridge end, hip and hip starter, header course, L-shaped rake edge, roll rake edge, starter, end band, terminal eave closure and top fixture units.
4. Flat Shape: Type III, flat shingle or flat interlocking.
    a. Accessory Tiles: Ridge and closed ridge end, hip and hip starter, header course, L-shaped rake edge, starter, end band and terminal units.
5. Size: As directed.
    a. Provide clay roof tiles of diminishing widths for circular bays or round towers.
6. Finish and Texture: Matte, smooth, Matte, striated or Glazed, smooth.
7. Color: Terra cotta, Brown, Red, Blended red or Buff.

2.3 UNDERLAYMENT MATERIALS

A. Felt Underlayment: ASTM D226/D226M, Type II, asphalt-saturated organic felt or ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, fine mineral surfacing on both sides, unperforated.

B. Roll-Roofing Underlayment: ASTM D6380, Class M, Type II, asphalt-saturated and -coated organic felt, mineral-granule surfaced.

C. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D1970/D1970M, minimum of 55 mil (1.4 mm), 50 mil (1.3 mm) or 40 mil (1.0 mm) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

E. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D1970/D1970M, a minimum of 40 mil (1.0 mm) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified-asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

F. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40 mil (1.0 mm) thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified-asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C) according to ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C) according to ASTM D1970/D1970M.

2.4 PLASTIC RIDGE VENTS

A. Rigid-Plastic Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge tiles.

1. Minimum Net Free Area: As directed.
2. Width: As directed.

3. Thickness: As directed.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M, Type II, asbestos free.

B. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone-based joint sealant of type, grade, class, and use classifications required to seal joints in clay-tile roofing and remain watertight.

D. Roofing Asphalt: ASTM D312, Type IV.

E. Cold-Applied Adhesive: Manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with underlayments.

F. Mortar: ASTM C270, Type M, natural color or with ASTM C979/C979M, pigmented mortar matching the color of clay roof tiles for exposed-to-view mortar, and natural color for concealed-from-view mortar.

G. Foam Adhesive: Two-component, polyurethane expanding adhesive recommended for application by clay-roof-tile manufacturer.

H. Eave Closure: Manufacturer's standard EPDM, copper, stainless-steel, galvanized-steel or aluminum, mill finish eave closure formed to shape of clay roof tile.

I. Wood Nailers: Comply with requirements for pressure-preservative-treated wood in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry."

J. Mesh Fabric: 18-by-14 (1.1 by 1.4-mm) mesh of PVC-coated, glass-fiber thread.

2.6 FASTENERS

A. Roofing Nails: ASTM F1667, copper, 0.135 inch (3.43 mm), aluminum, 0.120 inch (3.05-mm) or hot-dip galvanized-steel, 0.120 inch (3.05 mm) diameter shank, sharp-pointed, conventional roofing nails with barbed shanks; minimum 3/8-inch- (10-mm-) diameter head; of sufficient length to penetrate 3/4 inch (19 mm) into substrate or through thickness of the sheathing, whichever is less.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

B. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile metal or plastic caps, 1 inch (25 mm) minimum diameter.

1. Provide cap nails complying with written instructions of synthetic-underlayment manufacturer.
2. Provide with minimum 0.0134 inch (0.34 mm) thick cap, and with minimum 0.105 inch (2.67 mm) thick shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing.

C. Wood Batten Nails: ASTM F1667; common or box, steel wire, flat head, and smooth shank.

D. Wire Ties: Copper, Brass or Stainless steel, 0.083 inch (2.11mm) minimum diameter.

E. Twisted-Wire-Tie System: Continuously twisted, two-wire unit with loops formed 6 inches (152 mm) apart, minimum 0.101 inch (2.57 mm) diameter copper wire and 0.064 inch (1.63 mm) diameter copper tie wires, 0.090 inch 2.29 mm) diameter stainless-steel wire and 0.040 inch (1.02 mm) diameter stainless-steel tie wires or 0.105 inch (2.67 mm) diameter galvanized-steel wire and 0.065 inch (1.65 mm) diameter galvanized-steel tie wires, with matching-metal folding clip anchors.

F. Single-Line, Wire-Tie System: Interconnecting eave-to-ridge system, minimum 0.101inch (2.57 mm) diameter copper, 0.090 inch (2.29 mm) diameter stainless-steel or 0.106 inch (2.69 mm) diameter galvanized-steel wire, preformed to accommodate clay roof tile type and application indicated.

G. Hook Nails: One-piece wind lock and clay roof tile fastener system, minimum 0.135 inch (3.43 mm) diameter brass, 0.135 inch (3.43 mm) diameter copper, 0.120 inch (3.05 mm) diameter stainless-steel or 0.120 inch (3.05 mm) diameter galvanized-steel wire, for direct deck nailing.

H. Tile Locks: Brass, Copper, Stainless-steel or Hot-dip galvanized-steel, 0.1 inch (2.5 mm) diameter wire device designed to secure butt edges of overlaid clay roof tiles.

I. Storm Clips: Brass, minimum 0.048 by ½ inch (1.22 by 13 mm), Stainless-steel, minimum 0.048 by ¼ inch (1.22 by 6 mm) or Hot-dip galvanized-steel, minimum 0.048 by ½ inch (1.22 by 13 mm) strap-type, L-shaped retainer clips designed to secure side edges of clay roof tiles. Provide with two fastener holes in base flange.

2.7 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Copper, Stainless steel, Zinc-tin alloy-coated stainless steel, Zinc-tin alloy-coated steel, Zinc-tin alloy-coated copper, Anodized aluminum or Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for design, dimensions, metal, and other characteristics of the item.

C. Sheet Metal Ridge Vent: Fabricate from 16 oz./sq. ft. (0.55 mm) thick copper sheet, terminating each side in V-shaped external baffles with venting holes producing net-free ventilating area of 2.65 sq. in./ft. (56 sq. cm/m).

D. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch (1.6 mm) thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 4 inches (102 mm) from pipe onto roof.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with clay roof tile manufacturer's written instructions and with recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.

1. Cover ridge or hip wood nailers with underlayment strips.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) in direction that sheds water. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.

C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a 19 inch (483 mm) wide starter course at eaves and completely cover with a 36 inch (914 mm) wide second course. Install succeeding 36 inch (914 mm) wide courses lapping previous courses 19 inches (483 mm) in shingle fashion. Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.

2. Apply a continuous layer of asphalt roofing cement over starter course and on felt underlayment surface to be concealed by succeeding courses as each felt course is installed. Apply over entire roof or at locations indicated on Drawings.
3. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) in direction that sheds water.
4. Terminate felt underlayment flush or extended up not less than 4 inches (102 mm) against sidewalls, curbs, chimneys, and other roof projections.

D. Double-Layer Felt/Roll-Roofing Underlayment:

1. Install single layer of felt underlayment on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.
2. Install roll-roofing underlayment, in parallel courses, on felt underlayment and in same direction. Lap sides a minimum of 3 inches (76 mm) or 4 inches (102 mm). Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm).

    a. Mechanically fasten over felt underlayment with fasteners located under side lap.
    b. Adhere to felt underlayment with solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature, uniform coating of cold-applied adhesive or uniform coating of asphalt roofing cement.

3. Terminate felt underlayment flush or extended up not less than 4 inches (102 mm) against chimneys, sidewalls, curbs, and other projections.

E. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer a minimum of 2 inches (51 mm) or 4 inches (102 mm) for side laps and 8 inches (203 mm) for end laps. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten with underlayment nails according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.

1. Install in single or double layer.
2. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.

F. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

G. Double-Layer Felt/Self-Adhering Sheet Underlayment:

1. Install single layer of felt underlayment on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

a. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.

2. Install self-adhering sheet underlayment, wrinkle free, on felt underlayment; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Lap sides not less than 3-1/2 inches (89 mm) in direction that sheds water. Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses. Roll laps with roller. Cover underlayment within seven days.

H. Valley Underlayment: Install two layers of 36 inch (914 mm) wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches (1829 mm). Lap ends of each layer at least 12 inches (305 mm) in direction that sheds water, and seal with asphalt roofing cement. Fasten each layer to roof deck with underlayment nails.

1. Lap roof-deck underlayment over first layer of valley underlayment at least 6 inches (152 mm).

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to clay roof tile manufacturer's written instructions and recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems."

B. Pipe Flashings: Form flashing around pipe penetrations and tile roofing. Fasten and seal to tile roofing.

C. Sheet Metal Ridge Vents: Install centrally, and mechanically fasten to wood ridge. Adhere each side to clay roof tile with elastomeric sealant.

1. Install fabric mesh over roof-deck air ventilation gaps to prevent insect entry.

3.3 WOOD NAILERS

A. Install wood nailers securely fastened to roof deck at the following locations:

1. Hips.
2. Ridges.
3. Rakes.

B. Install beveled wood cant at eaves and securely fasten to roof deck.

C. Install nominal 1 by 2 inch (25 by 51 mm) wood battens horizontally over ½ inch (13 mm) high, pressure-preservative-treated wood lath strips or in 48 inch (1219 mm) lengths with ends separated by 1/2 inch (13 mm)], at spacing required by clay roof tile manufacturer, and securely fasten to roof deck.

1. Install nominal 1 by 2 inch (25 by 51 mm) wood counter battens vertically spaced 24 inches (610 mm) apart and securely fasten to roof deck.

3.4 CLAY ROOF TILE INSTALLATION

A. General: Install clay roof tiles according to manufacturer's written instructions and recommendations in TRI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions" and NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.

1. Maintain uniform exposure and coursing of clay roof tiles throughout roof.
2. Extend tiles 2 inches (51 mm) over eave fasciae.
3. Nail Fastening: Drive nails to clear the clay roof tile so the tile hangs from the nail and is not drawn up.

    a. Install wire through nail holes of cut tiles that cannot be nailed directly to roof deck and fasten to nails driven into deck.

4. Wire-Tie Fastening: Install wire-tie systems and fasten clay roof tiles according to manufacturer's written instructions.
5. Mortar Setting: Install clay roof tile according to TRI/FRSA's "Concrete and Clay Roof Tile Installation Manual."
6. Foam-Adhesive Setting: Install clay roof tile according to TRI/FRSA's "Concrete and Clay Roof Tile Installation Manual."
7. Storm Clips: Install to capture edges of longitudinal sides of clay roof tiles and securely fasten to roof deck.
8. Tile Locks: Install to support and lock overlying tile butts to underlying tiles.
9. Cut and fit clay roof tiles neatly around roof vents, pipes, ventilators, and other projections through roof. Fill voids with mortar.
10. Install clay roof tiles with color blend approved by Architect.

B. Flat-Shingle Clay Roof Tile Installation:

1. Maintain 2 inch (51 mm) head lap between succeeding courses of clay roof tiles.

2. Offset joints by half the clay roof tile width in succeeding courses.
3. Extend clay roof tiles 1 inch (25 mm) over fasciae at rakes.
4. Install ridge tiles in V-ridge, saddle or mitered configuration with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant].

    a. Close voids where ridge tiles meet clay roof tiles with ridge closure tiles or mortar struck with face of ridge cover tiles.

5. Install hip tiles in V-ridge, saddle or mitered configuration. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Fill voids with mortar where hip tiles meet clay roof tiles, and strike mortar flush with face of hip cover tiles.

C. Flat Interlocking Clay Roof Tile Installation:

1. Provide minimum 3 inch (76 mm) lap between succeeding courses of clay roof tiles.
2. Offset joints by half the clay roof tile width in succeeding courses.
3. Install L-shaped rake tiles.
4. Install ridge tiles in V-ridge, saddle or mitered configuration with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Close voids where ridge tiles meet clay roof tiles with ridge closure tiles or mortar struck with face of ridge cover tiles.

5. Install hip tiles in V-ridge, saddle or mitered configuration. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Fill voids with mortar where hip tiles meet clay roof tiles, and strike mortar flush with face of hip cover tiles.

D. Low-Profile, Interlocking Clay Roof Tile Installation:

1. Provide minimum 3 inch (76 mm) lap between succeeding courses of clay roof tiles.
2. Install L-shaped rake tiles.
3. Install ridge tiles with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

E. High-Profile Clay Roof Tile Installation:

1. Install tile, sheet metal or EPDM eave closure.
2. Provide minimum 3 inch (76 mm) lap between succeeding courses of clay roof tiles.
3. Install rake tiles indicated.

4. Install ridge tiles with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

F. Open Valleys: Cut clay roof tiles at open valleys to form straight lines. Maintain uniform width of exposed open valley or Widen exposed portion of open valley 1/8 inch in 12 inches (1:96)] from highest to lowest point.

1. Drill or notch cut valley tiles and wire-tie to fastener placed clear of valley metal flashings.
2. Do not nail tiles to metal flashings.

G. Closed Valleys: Cut clay roof tiles at closed valleys to form straight lines, trimming upper concealed corners of tiles. Maintain uniform gap of 1/2 to 3/4 inch (13 to 19 mm) or 3/4 to 1 inch (19 to 25 mm) on either side of the water diverter at centerline of valley.

1. Drill or notch cut valley tiles and wire-tie to fastener placed clear of valley metal flashings.
2. Do not nail tiles to metal flashings.

3.5 PLASTIC RIDGE VENTS

A. Rigid-Plastic Ridge Vents: Install continuous ridge vents over clay roof tiles according to manufacturer's written instructions. Fasten with nails of sufficient length to penetrate substrate.

END OF SECTION 073213

SECTION 073216 - CONCRETE ROOF TILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete roof tiles.
2. Underlayment.
3. Ridge vents.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports for concrete roof tiles.

B. Evaluation reports for the following:

1. Concrete roof tiles, fasteners, and attachment systems.
2. Synthetic underlayment.
3. High-temperature self-adhering underlayment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide concrete roof tiles and related roofing materials identical to those of assemblies tested for Class A, Class B or Class C fire resistance according to ASTM E108 or UL 790 by Underwriters Laboratories, Inc. or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 CONCRETE ROOF TILES

A. Concrete Roof Tiles: ASTM C1492, molded- or extruded-concrete roof tile units of shape and configuration indicated, with integral color, and free of surface imperfections. Provide with fastening holes pre-punched at factory.

1. Weight: Normal, Medium or Light.
2. High-Profile Shape: Type I, Spanish or "S" or Spanish or "S," interlocking.
    a. Accessory Tiles: Type IV, ridge, ridge vent, ridge end, hip and hip starter, header course, L-shaped rake edge, roll rake edge, starter or end band and terminal units.
3. Medium-Profile Shape: Type II, French interlocking.
    a. Accessory Tiles: Type IV, ridge, ridge vent, ridge end, hip and hip starter, header course, L-shaped rake edge, roll rake edge, starter or end band and terminal units.
4. Low-Profile Shape: Type III, flat shingle or flat interlocking.
    a. Accessory Tiles: Type IV, Ridge and closed ridge end, hip and hip starter, header course, L-shaped rake edge, starter or end band and terminal units.
5. Size: As directed.
6. Finish and Texture: Matte, smooth; Matte, striated or Glazed, smooth.
7. Colors, Blends, and Patterns: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

A. Felt Underlayment: ASTM D226/D226M, Type II, asphalt-saturated organic felt or ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, fine mineral surfacing on both sides, unperforated.

B. Roll-Roofing Underlayment: ASTM D6380, Class M, Type II, asphalt-saturated and -coated organic felt, mineral-granule surfaced.

C. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

D. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D1970/D1970M, minimum of 55 mil (1.4 mm), 50 mil (1.3 mm) or 40 mil (1.0 mm) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

E. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D1970/D1970M, minimum of 40 mil (1.0 mm) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified-asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

F. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40 mil (1.0 mm) thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified-asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C) according to ASTM D1970/D1970M.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C) according to ASTM D1970/D1970M.

2.4 PLASTIC RIDGE VENTS

A. Rigid-Plastic Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge tiles.

1. Minimum Net Free Area: As directed.
2. Width: As directed.
3. Thickness: As directed.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M, Type II, asbestos free.

B. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.

C. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone based joint sealant of type, grade, class, and use classifications required to seal joints in concrete-tile roofing and remain watertight.

D. Roofing Asphalt: ASTM D312, Type IV.

E. Cold-Applied Adhesive: Manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with underlayments.

F. Mortar: ASTM C270, Type M, natural color or with ASTM C979/C979M, pigmented mortar matching the color of concrete roof tiles for exposed-to-view mortar, and natural color for concealed-from-view mortar.

G. Foam Adhesive: Two-component, polyurethane expanding adhesive recommended for application by concrete-roof-tile manufacturer.

H. Eave Closure: Manufacturer's standard EPDM, copper, stainless-steel, galvanized-steel or aluminum, mill finish eave closure formed to shape of concrete roof tiles.

I. Ridge Closure: Manufacturer's standard EPDM ridge closure, formed to shape of concrete roof tiles.

J. Wood Nailers: Comply with requirements for pressure-preservative-treated wood in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry."

K. Mesh Fabric: 18 by 14 (1.1 by1.4 mm) mesh of PVC-coated, glass-fiber thread.

2.6 FASTENERS

A. Roofing Nails: ASTM F1667, copper, 0.135 inch (3.43 mm), aluminum, 0.120 inch (3.05 mm) or hot-dip galvanized-steel, 0.120 inch (3.05 mm) diameter shank, sharp-pointed, conventional roofing nails with barbed shanks; minimum 3/8 inch (10 mm) diameter head; of sufficient length to penetrate 3/4 inch (19 mm) into substrate or through thickness of the sheathing, whichever is less.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

B. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile metal or plastic caps, 1 inch (25 mm) minimum diameter.

1. Provide cap nails complying with written instructions of synthetic-underlayment manufacturer.
2. Provide with minimum 0.0134 inch (0.34 mm) thick cap, and with minimum 0.105 inch (2.67 mm) thick shank of length to penetrate at least 3/4 inch (19 mm) into roof sheathing.

C. Wood Batten Nails: ASTM F1667; common or box, steel wire, flat head, and smooth shank.

D. Wire Ties: Copper, Brass or Stainless steel, 0.083 inch (2.11mm) minimum diameter.

E. Twisted-Wire-Tie System: Continuously twisted, two-wire unit with loops formed 6 inches (152 mm) apart, minimum 0.101 inch (2.57 mm) diameter copper wire and 0.064 inch (1.63 mm) diameter copper tie wires, 0.090 inch (2.29 mm) diameter stainless-steel wire and 0.040 inch (1.02 mm) diameter stainless-steel tie wires or 0.105 inch (2.67 mm) diameter galvanized-steel wire and 0.065 inch (1.65 mm) diameter galvanized-steel tie wires, with matching-metal folding clip anchors.

F. Hook Nails: One-piece wind lock and concrete roof tile fastener system, minimum 0.135 inch (3.43 mm) diameter brass, 0.135 inch (3.43 mm) diameter copper, 0.120 inch (3.05 mm) diameter stainless-steel or 0.120 inch (3.05 mm) diameter galvanized-steel wire, for direct deck nailing.

G. Tile Locks: Brass, Copper, Stainless-steel or Hot-dip galvanized-steel, 0.1 inch (2.5 mm) diameter wire device designed to secure butt edges of overlaid concrete roof tiles.

H. Storm Clips: Brass, minimum 0.048 by 1/2-inch (1.22 by 13-mm), Stainless-steel, minimum 0.048 by ¼ inch (1.22 by 6 mm) or Hot-dip galvanized-steel, minimum 0.048 by ½ inch (1.22 by 13 mm) strap-type, L-shaped retainer clips designed to secure side edges of concrete roof tiles. Provide with two fastener holes in base flange.

2.7 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Copper, Stainless steel, Zinc-tin alloy-coated stainless steel, Zinc-tin alloy-coated steel, Zinc-tin alloy-coated copper, Anodized aluminum or Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for design, dimensions, metal, and other characteristics of the item.

C. Sheet Metal Ridge Vent: Fabricate from 16 oz./sq. ft. (0.55 mm) thick copper sheet, terminating each side in V-shaped external baffles with venting holes producing net-free ventilating area of 2.65 sq. in./ft. (56 sq. cm/m).

D. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch (1.6 mm) thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 4 inches (102 mm) from pipe onto roof.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. General: Comply with concrete roof tile manufacturer's written instructions and with recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.

1. Cover ridge or hip wood nailers with underlayment strips.

B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) in direction that sheds water. Lap ends of felt not less than 6 inches (152 mm) over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6-inch (152-mm) spacing at side laps.

C. Double-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Install a 19 inch (483 mm) wide starter course at eaves and completely cover with a 36 inch (914 mm) wide second course. Install succeeding 36 inch (914 mm) wide courses lapping previous courses 19 inches (483 mm) in shingle fashion. Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

1. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.
2. Apply a continuous layer of asphalt roofing cement over starter course and on felt underlayment surface to be concealed by succeeding courses as each felt course is installed. Apply over entire roof or at locations indicated on Drawings.
3. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches (76 mm) or 4 inches (102 mm) where overlap is in direction that sheds water.
4. Terminate felt underlayment flush or extended up not less than 4 inches (102 mm) against sidewalls, curbs, chimneys, and other roof projections.

D. Double-Layer Felt/Roll-Roofing Underlayment:

1. Install single layer of felt underlayment on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.
2. Install roll-roofing underlayment, in parallel courses, on felt underlayment and in same direction. Lap sides a minimum of 3 inches (76 mm) or 4 inches (102 mm)]. Lap ends a minimum of 6 inches (152 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm).

a. Mechanically fasten over felt underlayment with fasteners located under side lap.
b. Adhere to felt underlayment with solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature, uniform coating of cold-applied adhesive or uniform coating of asphalt roofing cement.

3. Terminate felt underlayment flush or extended up not less than 4 inches (102 mm) against chimneys, sidewalls, curbs, and other projections.

E. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer but a minimum of 2 inches (51 mm) or 4 inches (102 mm) for side laps and 8 inches (203 mm) for end laps. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten with underlayment nails according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.

1. Install in single or double layer.
2. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152-mm) spacing at side laps.

F. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.

G. Double-Layer Felt/Self-Adhering Sheet Underlayment:

1. Install single layer of felt underlayment on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (51 mm) or 4 inches (102 mm) over underlying course. Lap ends a minimum of 4 inches (102 mm). Stagger end laps between succeeding courses at least 72 inches (1829 mm). Fasten with underlayment nails.

a. Install fasteners at no more than 36 inches (914 mm) o.c. or 12 inches (305 mm) o.c. between side laps and 6 inch (152 mm) spacing at side laps.

2. Install self-adhering sheet underlayment, wrinkle free, on felt underlayment; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Lap sides not less than 3-1/2 inches (89 mm) in direction that sheds water. Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses. Roll laps with roller. Cover underlayment within seven days.

H. Valley Underlayment: Install two layers of 36 inch (914 mm) wide felt underlayment centered in valley. Stagger end laps between layers at least 72 inches (1829 mm). Lap ends of each layer at least 12 inches (305 mm) in direction that sheds water, and seal with asphalt roofing cement. Fasten each layer to roof deck with underlayment nails.

1. Lap roof-deck underlayment over first layer of valley underlayment at least 6 inches (152 mm).

3.2 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to concrete roof tile manufacturer's written instructions and recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems."

B. Pipe Flashings: Form flashing around pipe penetrations and tile roofing. Fasten and seal to tile roofing.

C. Sheet Metal Ridge Vents: Install centrally, and mechanically fasten to wood ridge. Adhere each side to concrete roof tile with elastomeric sealant.

1. Install fabric mesh over roof-deck air ventilation gaps to prevent insect entry.

3.3 WOOD NAILERS

A. Install wood nailers securely fastened to roof deck at the following locations:

1. Hips.
2. Ridges.
3. Rakes.

B. Install beveled wood cant at eaves and securely fasten to roof deck.

C. Install nominal 1 by 2 inch (25 by 51mm) wood battens horizontally over ½ inch (13 mm) high, pressure-preservative-treated wood lath strips or in 48 inch (1219 mm) lengths with ends separated by 1/2 inch (13 mm), at spacing required by concrete roof tile manufacturer, and securely fasten to roof deck.

1. Install nominal 1 by 2 inch (25 by 51 mm) wood counter battens vertically spaced 24 inches (610 mm) apart and securely fasten to roof deck.

3.4 CONCRETE ROOF TILE INSTALLATION

A. General: Install concrete roof tiles according to manufacturer's written instructions and with recommendations in TRI/WSRCA's "Concrete and Clay Roof Tile Design Criteria Installation Manual for Moderate Climate Regions" and NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems" unless more stringent requirements are indicated.

1. Maintain uniform exposure and coursing of concrete roof tiles throughout roof.
2. Extend tiles 2 inches (51 mm) over eave fasciae.
3. Nail Fastening: Drive nails to clear the concrete roof tile so the tile hangs from the nail and is not drawn up.

a. Install wire through nail holes of cut tiles that cannot be nailed directly to roof deck, and fasten to nails driven into deck.

4. Wire-Tie Fastening: Install wire-tie systems and fasten concrete roof tiles according to manufacturer's written instructions.
5. Mortar Setting: Install concrete roof tiles according to TRI/FRSA's "Concrete and Clay Roof Tile Installation Manual."
6. Foam-Adhesive Setting: Install concrete roof tiles according to TRI/FRSA's "Concrete and Clay Roof Tile Installation Manual."
7. Storm Clips: Install to capture edges of longitudinal sides of concrete roof tiles and securely fasten to roof deck.
8. Tile Locks: Install to support and lock overlying tile butts to underlying tiles.
9. Cut and fit concrete roof tiles neatly around roof vents, pipes, ventilators, and other projections through roof. Fill voids with mortar.
10. Install concrete roof tiles with color blend approved by Architect.

B. Low-Profile, Flat-Shingle Concrete Roof Tile Installation:

1. Maintain 2 inch (51mm) head lap between succeeding courses of concrete roof tiles.
2. Offset joints by half the concrete roof tile width in succeeding courses.
3. Extend concrete roof tiles 1 inch (25 mm) over fasciae at rakes.
4. Install ridge tiles in V-ridge, saddle or mitered configuration with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Close voids where ridge tiles meet concrete roof tiles with ridge closure tiles or mortar struck with face of ridge cover tiles.

5. Install hip tiles in V-ridge, saddle or mitered configuration. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Fill voids with mortar where hip tiles meet concrete roof tiles, and strike mortar flush with face of hip cover tiles.

C. Low-Profile, Flat Interlocking Concrete Roof Tile Installation:

1. Provide minimum 3-inch (76 mm) lap between succeeding courses of concrete roof tiles.
2. Offset joints by half the concrete roof tile width in succeeding courses.
3. Install L-shaped rake tiles.
4. Install ridge tiles in V-ridge, saddle or mitered configuration with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Close voids where ridge tiles meet concrete roof tiles with ridge closure tiles or mortar struck with face of ridge cover tiles.

5. Install hip tiles in V-ridge, saddle or mitered configuration. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

    a. Fill voids with mortar where hip tiles meet concrete roof tiles, and strike mortar flush with face of hip cover tiles.

D. Medium-Profile, Interlocking Concrete Roof Tile Installation:

1. Provide minimum 3-inch (76 mm) lap between succeeding courses of concrete roof tiles.
2. Install rake tiles.
3. Install ridge tiles with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

E. High-Profile Concrete Roof Tile Installation:

1. Install tile, sheet metal or EPDM eave closure.
2. Provide minimum 3-inch (76 mm) lap between succeeding courses of concrete roof tiles.
3. Install rake tiles indicated.
4. Install ridge tiles with laps facing away from prevailing wind. Seal laps with asphalt roofing cement, butyl sealant or elastomeric sealant.

F. Open Valleys: Cut concrete roof tiles at open valleys to form straight lines. Maintain uniform width of exposed open valley or widen exposed portion of open valley 1/8 inch in 12 inches (1:96) from highest to lowest point.

1. Drill or notch cut valley tiles and wire-tie to fastener placed clear of valley metal flashings.
2. Do not nail tiles to metal flashings.

G. Closed Valleys: Cut concrete roof tiles at closed valleys to form straight lines, trimming upper concealed corners of tiles. Maintain uniform gap of 1/2 to 3/4 inch (13 to 19 mm) or 3/4 to 1 inch (19 to 25 mm) on either side of the water diverter at centerline of valley.

1. Drill or notch cut valley tiles and wire-tie to fastener placed clear of valley metal flashings.
2. Do not nail tiles to metal flashings.

3.5 PLASTIC RIDGE VENTS

A. Rigid-Plastic Ridge Vents: Install continuous ridge vents over concrete roof tiles according to manufacturer's written instructions. Fasten with nails of sufficient length to penetrate substrate.

END OF SECTION 073216

SECTION 074113.13 - FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exposed-fastener, lap-seam, metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion or as directed.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low or steep slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements, as directed.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30, UL 60 or UL 90.

H. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 60, 75, 90, 105 or 120.
2. Hail Resistance: MH or SH.

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 EXPOSED-FASTENER, LAP-SEAM, METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Corrugated-Profile, Exposed-Fastener Metal Roof Panels: Formed with alternating curved ribs spaced at 2.67 inches (68 mm) o.c. across width of panel.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 21.3 inches (541 mm), 29.3 inches (744 mm), 34.67 inches (881 mm), 37.3 inches (947 mm), 42.67 inches (1084 mm) or 45.3 inches (1151 mm).
4. Panel Height: 0.5 inch (13 mm) or 0.875 inch (22 mm).

C. Tapered-Rib-Profile, Exposed-Fastener Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced or flat pan between major ribs.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Major-Rib Spacing: 6 inches (152 mm), 8 inches (203 mm), 9 inches (229 mm) or 12 inches (305 mm) o.c.
4. Panel Coverage: 24 inches (610 mm) or 36 inches (914 mm).
5. Panel Height: 0.625 inch (16 mm), 0.75 inch (19 mm), 1.0 inch (25 mm), 1.25 inches (32 mm) or 1.5 inches (38 mm).

D. Vee-Rib-Profile, Exposed-Fastener Metal Roof Panels: Formed with raised, V-shaped ribs and recesses that are approximately same size, evenly spaced across panel width, and with rib/recess sides angled at approximately 45 degrees.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or embossed] finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 5.3 inches (135 mm), 7.2 inches (183 mm) or 12 inches (305 mm) o.c.
4. Panel Coverage: 30 inches (762 mm), 32 inches (813 mm), 36 inches (914 mm) or 40 inches (1016 mm).
5. Panel Height: 1.375 inches (35 mm), 1.5 inches (38 mm), 1.75 inches (44 mm), 2.0 inches (51 mm) or 3.0 inches (76 mm).

E. Box-Rib-Profile, Exposed-Fastener Metal Roof Panels: Formed with raised, box-shaped ribs that are wider than recesses, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 2.67 inches (68 mm), 4.0 inches (102 mm), 5.3 inches (135 mm) or 6.0 inches (152 mm) o.c.
4. Panel Coverage: 24 inches (610 mm), 28 inches (711 mm), 30 inches (762 mm) 32 inches (813 mm) or 36 inches (914 mm).
5. Panel Height: 0.625 inch (16 mm), 1.0 inch (25 mm), 1.5 inches (38 mm) or 2.0 inches (51 mm).

F. Deep-Box-Rib-Profile, Exposed-Fastener Metal Roof Panels: Formed with raised, box-shaped ribs that are wider than recesses, evenly spaced across panel width, and with rib/recess sides angled more than 60 degrees.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.

c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 12 inches (305 mm) o.c.
4. Panel Coverage: 24 inches (610 mm).
5. Panel Height: 3 inches (76 mm) or 4 inches (102 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 220 deg F (111 deg C); ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D1970.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25-mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels or roof fascia and rake trim.

E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2 mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52 mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below or on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. Apply over the roof area indicated below:

    a. Roof perimeter for a distance up from eaves of 24 inches (610 mm) or 36 inches (914 mm) beyond interior wall line.
    b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (152 mm).
    c. Rake edges for a distance of 18 inches (460 mm).
    d. Hips and ridges for a distance on each side of 12 inches (305 mm).
    e. Roof-to-wall intersections for a distance from wall of 18 inches (460 mm).
    f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

B. Felt Underlayment: Apply at locations indicated below or on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).

1. Apply over the entire roof surface.
2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.
6. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch (152 mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

3.4 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.13

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low or steep slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30, UL 60 or UL 90.

H. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-60, 75, 90, 105 or 120.
2. Hail Resistance: MH or SH.

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated

steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed or Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch (0.71mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

4. Panel Coverage: 10 inches (254 mm), 12 inches (305 mm), 14 inches (356 mm), 16 inches (406 mm), 18 inches (457 mm) or 24 inches (610 mm).
5. Panel Height: 1.0 inch (25 mm), 1.5 inches (38 mm) or 1.75 inches (44 mm).

C. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed or Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch (0.71mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

4. Joint Type: Single folded, Double folded or as standard with manufacturer.
5. Panel Coverage: 12 inches (305 mm), 14 inches (356 mm), 16 inches (406 mm), 18 inches (457 mm), 20 inches (508 mm) or 24 inches (610 mm).
6. Panel Height: 1.5 inches (38 mm), 2.0 inches (51 mm) or 2.5 inches (64 mm).

D. Trapezoidal-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed or Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch (0.71 mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

4. Panel Coverage: 12 inches (305 mm), 18 inches (457 mm) or 24 inches (610 mm).
5. Panel Height: 3 inches (76 mm).

E. Trapezoidal-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed or Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch (0.71 mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

4. Joint Type: Single folded, Double folded or as standard with manufacturer.
5. Panel Coverage: 12 inches (305 mm), 18 inches (457 mm) or 24 inches (610 mm).
6. Panel Height: 2.7 inches (69 mm) or 3.0 inches (76 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D1970.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are

not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels or roof fascia and rake trim.

E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2 mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52 mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below or on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. Apply over the roof area indicated below:

    a. Roof perimeter for a distance up from eaves of 24 inches (610 mm) or 36 inches (914 mm) beyond interior wall line.
    b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (152 mm).
    c. Rake edges for a distance of 18 inches (460 mm).
    d. Hips and ridges for a distance on each side of 12 inches (305 mm).
    e. Roof-to-wall intersections for a distance from wall of 18 inches (460 mm).
    f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

B. Felt Underlayment: Apply at locations indicated below or on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).

1. Apply over the entire roof surface.
2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch (152 mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16

SECTION 074113.19 - BATTEN-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes batten-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

B. Energy Performance: Provide roof panels with an aged Solar Reflectance Index of not less than 0.64 when tested according to CRRC-1.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30, UL 60 or UL 90.

H. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-60, 75, 90, 105 or 120.
2. Hail Resistance: MH or SH.

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 BATTEN-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panel assembly designed to be installed by covering vertical side edges of adjacent panels with battens and mechanically attaching panels to supports using concealed clips. Include battens and accessories required for weathertight installation.

B. Narrow-Profile, Snap-on-Batten-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for independent installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging the opposite edge of adjacent panels, and installing 3/8 to 1/2-inch (10 to 13 mm) wide, snap-on battens over panel joints.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

   a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
   b. Surface: Smooth, flat or Embossed finish.
   c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
   d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Batten Material: Same material, finish, and color as roof panels.
4. Clips: One-piece fixed or Two-piece floating to accommodate thermal movement.

   a. Material: 0.028-inch (0.71 mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
   b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

5. Panel Coverage: 12 inches (305 mm), 14 inches (356 mm), 16 inches (406 mm), 18 inches (457 mm) or 20 inches (508 mm).
6. Batten Height: 1.0 inch (25 mm), 1.25 inches (32 mm), 1.5 inches (38 mm), 1.75 inches (44 mm) or 2.0 inches (51 mm).

C. Wide-Profile, Snap-on-Batten-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for independent installation by mechanically attaching panels to supports using concealed clips located between panels, engaging the opposite edge of adjacent panels, and installing snap-on battens over panel joints.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

   a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
   b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
   c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Batten Material: Same material, finish, and color as roof panels.
4. Clips: One-piece fixed or two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch (0.71 mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

5. Panel Coverage: 12 inches (305 mm), 14 inches (356 mm), 16 inches (406 mm), 18 inches (457 mm), 22 inches (559 mm) or 24 inches (610 mm).
6. Batten Height: 1.0 inch (25 mm), 1.5 inches (38 mm), 1.75 inches (44 mm), 1.88 inches (48 mm) or 2.0 inches (51 mm).

D. Seamed-Batten Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a smooth, flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging the opposite edge of adjacent panels, and installing mechanically seamed battens over panel joints.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Batten Material: Same material, finish, and color as roof panels.
4. Clips: One-piece fixed or two-piece floating to accommodate thermal movement.

    a. Material: 0.028-inch (0.71 mm) or 0.064-inch (1.63 mm) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
    b. Material: 0.025-inch (0.64 mm) or 0.062-inch (1.59 mm) thick, stainless-steel sheet.

5. Panel Coverage: 12 inches (305 mm), 18 inches (457 mm) or 24 inches (610 mm).
6. Panel Height: 3 inches (76 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D1970.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels or roof fascia and rake trim.

E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2 mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52 mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below or on Drawings wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.
2. Apply over the roof area indicated below:

    a. Roof perimeter for a distance up from eaves of 24 inches (610 mm) or 36 inches (914 mm) beyond interior wall line.
    b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (152 mm).
    c. Rake edges for a distance of 18 inches (460 mm).
    d. Hips and ridges for a distance on each side of 12 inches (305 mm).
    e. Roof-to-wall intersections for a distance from wall of 18 inches (460 mm).

f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

B. Felt Underlayment: Apply at locations indicated below or on Drawings, in shingle fashion to shed water, and with lapped joints of not less than 2 inches (50 mm).

1. Apply over the entire roof surface.
2. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

A. Batten-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each batten-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling fasteners.
2. Apply battens to metal roof panel seams, fully engaged to provide weathertight joints.
3. Watertight Installation:

a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend by manufacturer as needed to make panels watertight.
b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
c. At panel splices, nest panels with minimum 6-inch (152 mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

3.4 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.19

SECTION 074116 - INSULATED METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulated metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for low or steep slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 30, UL 60 or UL 90.

G. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-60, 75, 90, 105 or 120.
2. Hail Resistance: MH or SH.

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 FOAMED-INSULATION-CORE METAL ROOF PANELS

A. General: Provide factory-formed and -assembled metal roof panels fabricated from two sheets of metal with insulation core foamed in place during fabrication with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:

a. Flatwise Tensile Strength: 30 psi (200 kPa) when tested according to ASTM C297/C297M.
b. Humid Aging: Volume increase not greater than 6.0 percent and no delamination or metal corrosion when tested for seven days at 140 deg F (60 deg C) and 100 percent relative humidity according to ASTM D2126.
c. Heat Aging: Volume increase not greater than 2.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at 200 deg F (93 deg C) according to ASTM D2126.
d. Cold Aging: Volume decrease not more than 1.0 percent and no delamination, surface blistering, or permanent bowing when tested for seven days at minus 20 deg F (29 deg C) according to ASTM D2126.
e. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. (958-kPa) positive and negative wind load and with deflection of L/180 for 2 million cycles.
f. Autoclave: No delamination when exposed to 2-psi (13.8-kPa) pressure at a temperature of 212 deg F (100 deg C) for 2-1/2 hours.
g. Fire-Test-Response Characteristics: Class A according to ASTM E108.

2. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226.

b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D1622.
c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D1621.
d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C273.

B. Lap-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels: Formed for lapping side edges of adjacent panels and mechanically attaching to supports using exposed fasteners in side laps.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm) or 0.034 inch (0.86 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Batten: Same material, finish, and color as exterior facings of roof panels.
3. Panel Coverage: 24 inches (610 mm), 30 inches (762 mm), 36 inches (914 mm), 39.6 inches (1000 mm), 40 inches (1016 mm) or 44.5 inches (1130 mm).
4. Panel Thickness: 1.0 inch (25 mm), 1.5 inches (38 mm), 2.0 inches (51 mm), 2.5 inches (64 mm), 3.0 inches (76 mm), 4.0 inches (102 mm), 5.0 inches (127 mm) or 6.0 inches (152 mm).
5. Thermal-Resistance Value (R-Value): According to ASTM C1363.

C. Standing-Seam-Profile, Foamed-Insulation-Core Metal Roof Panels: Formed with vertical tongue-and-groove ribs at panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between ribs; designed for sequential installation by interlocking tongue-and-groove panel edges and mechanically attaching panels to supports using concealed clips located between panels and engaging edges of adjacent panels, and mechanically seaming panels together.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm) or 0.034 inch (0.86 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Joint Type: Single folded, Double folded or as standard with manufacturer.
3. Panel Coverage: 36 inches (914 mm) or 42 inches (1067 mm).
4. Panel Thickness: 2.0 inches (51 mm), 2.5 inches (64 mm), 3.0 inches (76 mm), 4.0 inches (102 mm), 5.0 inches (127 mm) or 6.0 inches (152 mm).
5. Thermal-Resistance Value (R-Value): According to ASTM C1363.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as exterior facings of metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters and Downspouts: Formed from same material, finish, and color as exterior facings of panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels or roof fascia and rake trim.

E. Roof Curbs: Fabricated from same material, finish, and color as exterior facings of roof panels, 0.048-inch (1.2 mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52 mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers for exposed fasteners.

G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Exterior Facings and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

B. Interior Facings:

1. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
2. Acrylic or Polyester Finish: Manufacturer's standard white or light-colored acrylic or polyester finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 METAL PANEL INSTALLATION

A. Lap-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full-rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or applications not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of insulated metal roof panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Provide sealant tape at lapped joints of insulated metal roof panels and between panels and protruding equipment, vents, and accessories.
5. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to weatherproof panels.
6. Apply snap-on battens to seams of insulated metal roof panels to conceal fasteners.

B. Standing-Seam, Foamed-Insulation-Core Metal Roof Panels: Fasten insulated metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.

2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so cleat, insulated metal roof panel, and factory-applied side-lap sealant are completely engaged.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074116

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.
2. Concealed-fastener, lap-seam metal wall panels.
3. Metal liner panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Corrugated-Profile, Exposed-Fastener Metal Wall Panels: Formed with alternating curved ribs spaced at 2.67 inches (68 mm) o.c. across width of panel.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 2.67 inches (68 mm) o.c.
4. Panel Coverage: 21.3 inches (541 mm), 29.3 inches (744 mm), 34.6 inches (881 mm), 37.3 inches (947 mm), 42.6 inches (1084 mm) or 45.3 inches (1151 mm).
5. Panel Height: 0.5 inch (13 mm) or 0.875 inch (22 mm).

C. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced or a flat pan between major ribs.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Major-Rib Spacing: 6 inches (152 mm), 8 inches (203 mm), 9 inches (229 mm) or 12 inches (305 mm) o.c.
4. Panel Coverage: 24 inches (610 mm) or 36 inches (914 mm).
5. Panel Height: 0.625 inch (16 mm), 0.75 inch (19 mm), 1.0 inch (25 mm), 1.25 inches (32 mm) or 1.5 inches (38 mm).

D. Reverse-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with recessed, trapezoidal major valleys and intermediate stiffening valleys symmetrically spaced or a flat pan between major valleys.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

E. Vee-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, V-shaped ribs and recesses that are approximately same size, evenly spaced across panel width, and with rib/recess sides angled at approximately 45 degrees.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 5.3 inches (135 mm), 7.2 inches (183 mm) or 12 inches (305 mm) o.c.
4. Panel Coverage: 30 inches (762 mm), 32 inches (813 mm), 36 inches (914 mm) or 40 inches (1016 mm).
5. Panel Height: 1.375 inches (35 mm), 1.5 inches (38 mm), 1.75 inches (44 mm), 2.0 inches (51 mm) or 3.0 inches (76 mm).

F. Box-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed] finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 2.67 inches (68 mm), 4.0 inches (102 mm), 5.3 inches (135 mm) or 6.0 inches (152 mm) o.c.
4. Panel Coverage: 24 inches (610 mm), 28 inches (711 mm), 30 inches (762 mm), 32 inches (813 mm) or 36 inches (914 mm).
5. Panel Height: 0.625 inch (16 mm), 1.0 inch (25 mm), 1.5 inches (38 mm) or 2.0 inches (51 mm).

G. Deep-Box-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled more than 60 degrees.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Rib Spacing: 12 inches (305 mm) o.c.
4. Panel Coverage: 24 inches (610 mm).
5. Panel Height: 3.0 inches (76 mm) or 4.0 inches (102 mm).

2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges; with flush joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches (305 mm).
4. Panel Height: 1.0 inch (25 mm)] [1.5 inches (38 mm).

C. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges; with narrow reveal joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches (305 mm).
4. Panel Height: 1.0 inch (25 mm) or 1.5 inches (38 mm).

D. Wide-Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a stepped profile between panel edges, resulting in a wide reveal joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches (305 mm).
4. Panel Height: 1.5 inches (38 mm).

E. V-Groove-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 6 inches (152 mm), 8 inches (203 mm) or 12 inches (305 mm).
4. Panel Height: 0.625 inch (16 mm) or 1.25 inches (32 mm).

F. Creased-Rib-Profile, Concealed-Fastener Metal Wall Panels: Formed with raised, center-creased, trapezoidal major ribs; with reveal joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated

steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed] finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches (305 mm).
4. Panel Height: 0.875 inch (22 mm) or 1.5 inches (38 mm).

2.4 METAL LINER PANELS

A. General: Provide factory-formed metal liner panels designed for interior side walls and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for a complete installation.

B. Metal Liner Panels: Solid or Perforated panels formed with intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges; with a flush joint between panels.

1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Panel Coverage: 12 inches (305 mm), 16 inches (406 mm), 24 inches (610 mm) or 36 inches (914 mm).
4. Seam Profile: Flush, Tapered or Striated.
5. Seam Height: 1.5 inches (38 mm), 2.0 inches (51 mm) or 3.0 inches (76 mm).
6. Acoustical Performance: Where sound-absorption requirement is indicated, fabricate interior liner panels with 1/8-inch (3 mm) diameter holes uniformly spaced approximately 1000 holes/sq. ft. (10 750 holes/sq. m).

    a. NRC of not less than 0.65, 0.85 or 1.00 when tested according to ASTM C423.

2.5 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.6 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.7 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 METAL PANEL INSTALLATION

A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152 mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Metal Liner Panels: Install panels on exterior side of girts, with girts exposed to the interior or interior side of girts with flush appearance on the inside.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.13

SECTION 074213.16 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal plate wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 METAL PLATE WALL PANELS

A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

B. Panel Depth: 2 inches (51 mm) or as indicated on Drawings.

C. Aluminum Sheet: Tension-leveled, smooth aluminum sheet, ASTM B209 (ASTM B209M), 0.120 inch (3.05 mm), 0.125 inch (3.18 mm), 0.1875 inch (4.76 mm) or 0.190 inch (4.82 mm) thick.

1. Exterior Finish: Two-coat fluoropolymer or Three-coat fluoropolymer.

a. Color: As indicated by manufacturer's designations or match Architect's samples or as selected by Architect from manufacturer's full range.

D. Attachment Assembly: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; as recommended in writing by metal panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

B. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

C. Installation: Attach metal plate wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal plate wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
2. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners

where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.2 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.16

SECTION 074213.19 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foamed-insulation-core metal wall panels.
2. Laminated-insulation-core metal wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
4. Potential Heat: Acceptable level when tested according to NFPA 259.
5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested according to ASTM D6226.
b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D1622.
c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D1621.
d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C273/C273M.

B. Exposed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with a raised, trapezoidal major rib at panel edge and two intermediate stiffening ribs symmetrically spaced

between major rib and panel edge; designed for lapping side edges of adjacent panels and mechanically attaching to supports using exposed fasteners in side laps.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm) or 0.034 inch (0.86 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

    c. Interior Finish: Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Backer Board: On back side of exterior facing.
3. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
4. Panel Coverage: 36 inches (914 mm) nominal.
5. Panel Thickness: 3.0 inches (76 mm), 4.0 inches (102 mm) or 5.0 inches (127 mm).
6. Thermal-Resistance Value (R-Value): According to ASTM C1363.

C. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm) or 0.034 inch (0.86 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Backer Board: On back side of exterior facing.
3. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
4. Panel Coverage: 36 inches (914 mm) or 40 inches (1016 mm) nominal.
5. Panel Thickness: 1.0 inch (25 mm), 1.5 inches (38 mm), 2.0 inches (51 mm), 2.5 inches (64 mm), 3.0 inches (76 mm), 4.0 inches (102 mm) or 5.0 inches (127 mm).
6. Thermal-Resistance Value (R-Value): According to ASTM C1363.

2.3 LAMINATED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and core material laminated or otherwise securely bonded to facing sheets during fabrication without use of contact adhesives, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

B. Wrapped-Edge, Laminated-Insulation-Core Metal Wall Panels: Formed with flush exterior panel facing wrapped over panel edges; designed for independent installation by mechanically attaching panels to supports using staggered, concealed side clips engaging panel edges or through extended panel edges to supports using concealed fasteners; with sealant or gasketed joints.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, ASTM B209 (ASTM B209M),

alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm), 0.040 inch (1.02 mm), 0.050 inch (1.27 mm), 0.063 inch (1.60 mm) or 0.080 inch (2.03 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

d. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Core Material: Manufacturers' standard. Board insulation of the following type:

a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

1) Closed-Cell Content: 90 percent when tested according to ASTM D6226.

b. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density, unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.
c. Molded-Polystyrene Board Insulation: ASTM C578, Type I, 0.9 lb/cu. ft. (14 kg/cu. m) or Type II, 1.35 lb/cu. ft. (22 kg/cu. m), Class 2 or 3, Grade 3, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

4. Backer Board: 0.125-inch (3 mm) or 0.250-inch (6 mm)] thick hardboard behind exterior facing for increased impact resistance.
5. Clips: Manufacturer's standard one piece, formed from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet or stainless steel.
6. Gaskets: Extruded, dry seal silicone.
7. Sealant: Manufacturer's standard silicone.
8. Panel Thickness: 1.0 inch (25 mm), 2.0 inches (51 mm), 3.0 inches (76 mm), 4.0 inches (102 mm), 5.0 inches (127 mm) or 6.0 inches (152 mm).
9. Thermal-Resistance Value (R-Value): According to ASTM C1363.

C. Shiplap-Edge, Laminated-Insulation-Core Metal Wall Panels: Formed with flush exterior panel facing and with shiplap edges; designed for sequential installation by mechanically attaching panels to supports using concealed clips and fasteners; with factory-applied sealant or gaskets in side laps.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.028 inch (0.71 mm), 0.034 inch (0.86 mm) or 0.040 inch (1.02 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

    c. Interior Finish: Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm), 0.040 inch (1.02 mm), 0.050 inch (1.27 mm) or 0.063 inch (1.60 mm).
    b. Surface: Smooth, flat or Embossed] finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or As selected by Architect from manufacturer's full range.

    d. Interior Finish: Siliconized polyester.

        1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Core Material: Manufacturers' standard. Board insulation of the following type:

    a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

        1) Closed-Cell Content: 90 percent when tested according to ASTM D6226.

b. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.
c. Molded-Polystyrene Board Insulation: ASTM C578, Type I, 0.9 lb/cu. ft. (14 kg/cu. m) or Type II, 1.35 lb/cu. ft. (22 kg/cu. m), Class 2 or 3, Grade 3, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

4. Backer Board: 0.125-inch (3 mm) or 0.250-inch (6 mm) thick hardboard behind exterior facing for increased impact resistance.
5. Clips: Manufacturer's standard one piece, formed from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet or stainless steel.
6. Gaskets: Extruded, dry seal silicone.
7. Sealant: Manufacturer's standard silicone.
8. Panel Thickness: 1.0 inch (25 mm), 2.0 inches (51 mm), 3.0 inches (76 mm), 4.0 inches (102 mm), 5.0 inches (127 mm) or 6.0 inches (152 mm).
9. Thermal-Resistance Value (R-Value): According to ASTM C1363.

D. Framed-Edge, Laminated-Insulation-Core Metal Wall Panels: Formed with flush exterior panel facing and integral, extruded edge members; designed for independent installation by mechanically attaching panels to supports through edge framing using concealed fasteners; with gasketed joints.

1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

   a. Nominal Thickness: 0.028 inch (0.71 mm), 0.034 inch (0.86 mm) or 0.040 inch (1.02 mm).
   b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

      1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

   c. Interior Finish: Siliconized polyester.

      1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2. Aluminum Sheet: Fabricate panel with exterior and interior facings of same material and thickness. Provide facings of aluminum coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm), 0.040 inch (1.02 mm), 0.050 inch (1.27 mm), 0.063 inch (1.60 mm) or 0.080 inch (2.03 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

d. Interior Finish: Siliconized polyester.

1) Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Core Material: Manufacturers' standard. Board insulation of the following type:

a. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, board type, with a maximum flame-spread index of 25 and a smoke-developed index of 450.

1) Closed-Cell Content: 90 percent when tested according to ASTM D6226.

b. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density unless otherwise indicated; with a maximum flame-spread index of 25 and a smoke-developed index of 450.
c. Molded-Polystyrene Board Insulation: ASTM C578, Type I, 0.9 lb/cu. ft. (14 kg/cu. m) or Type II, 1.35 lb/cu. ft. (22 kg/cu. m), Class 2 or 3, Grade 3, with maximum flame-spread index of 25 and smoke-developed index of 450.

4. Backer Board: 0.125-inch (3 mm) or 0.250-inch (6 mm) thick hardboard behind exterior facing for increased impact resistance.
5. Edge Members: Extruded aluminum, not less than 0.063-inch (1.60-mm) wall thickness.
6. Gaskets: Extruded, dry seal silicone.
7. Panel Thickness: 1.0 inch (25 mm), 2.0 inches (51 mm), 3.0 inches (76 mm), 4.0 inches (102 mm), 5.0 inches (127 mm) or 6.0 inches (152 mm).
8. Thermal-Resistance Value (R-Value): According to ASTM C1363.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, 1/8 inch (3 mm) or 1/4 inch (6 mm) thick unless otherwise indicated.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Laminated-Insulation-Core Metal Wall Panels:

1. Wrapped-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging wrapped panel edges. Install clips to supports with self-tapping fasteners. Seal joints with backer rod and sealant or manufacturer's standard gaskets.
2. Wrapped-Edge Panels: Mechanically attach wall panels through extended edge of panels to supports using self-tapping fasteners. Seal joints with backer rod and sealant or manufacturer's standard gaskets.
3. Shiplap-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging tongue-and-groove panel edges. Install clips to supports with self-tapping fasteners.

    a. Horizontal Joints: Maintain reveal joint of consistent width, Seal joints with backer rod and sealant or Seal joints with manufacturer's standard gaskets.
    b. Vertical Joints: Maintain reveal joint of consistent width, Seal joints with backer rod and sealant or Seal joints with manufacturer's standard gaskets.

4. Framed-Edge Panels: Mechanically attach wall panels through integral, extruded edge members to supports using self-tapping fasteners. Seal joints with manufacturer's standard gaskets.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.19

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal composite material wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal composite material panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

F. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assemblies, components, panel stiffeners, and accessories required for weathertight system.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch (0.50 mm) thick, coil-coated or anodized aluminum sheet facings.

1. Panel Thickness: 0.118 inch (3 mm), 0.157 inch (4 mm), 0.197 inch (5 mm), 0.236 inch (6 mm) or as indicated on Drawings.
2. Core: Standard or Fire retardant.
3. Exterior Finish: Two-coat fluoropolymer or Three-coat fluoropolymer.

a. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Attachment Assembly Components: Formed from extruded aluminum.

D. Attachment Assembly: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; as recommended in writing by metal composite material panel manufacturer. Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal composite material panel manufacturer's written recommendations.

3.2 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

B. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite materialwall panels with manufacturer's standard gasket system.
3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.23

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

D. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 or 1/240 of the span.
4. Serviceability requirements: As directed.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal wall or roof panels.

1. Finish: Match finish and color of metal wall panels, match finish and color of metal roof panels or as indicated on Drawings.
2. Sealant: Factory applied within interlocking joint.

C. Flush-Profile Metal Soffit Panels: Solid or Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced a flat pan between panel edges; with flush joint between panels.

1. Material: Same material, finish, and color as metal wall or roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

4. Panel Coverage: 8 inches (203 mm), 12 inches (305 mm), 16 inches (406 mm) or 20 inches (508 mm).
5. Panel Height: 0.875 inch (22 mm), 1.0 inch (25 mm), 1.5 inches (38 mm) or 3.0 inches (76 mm).

D. Reveal-Joint-Profile Metal Soffit Panels: Solid or Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges; with recessed reveal joint between panels.

1. Material: Same material, finish, and color as metal wall or roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).
    b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
    b. Surface: Smooth, flat or Embossed finish.
    c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
    d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

4. Panel Coverage: 8 inches (203 mm), 12 inches (305 mm), 16 inches (406 mm) or 20 inches (508 mm).
5. Panel Height: 0.75 inch (19 mm), 1.0 inch (25 mm) or 1.5 inches (38 mm).

E. V-Groove-Profile Metal Soffit Panels: Solid or Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced or a flat pan between panel edges; with a V-groove joint between panels.

1. Material: Same material, finish, and color as metal wall or roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Nominal Thickness: 0.022 inch (0.56 mm), 0.028 inch (0.71 mm), 0.034 inch (0.86 mm), 0.040 inch (1.02 mm) or 0.052 inch (1.32 mm).

b. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
c. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209 (ASTM B209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm).
b. Surface: Smooth, flat or Embossed finish.
c. Exterior Finish: Two-coat fluoropolymer, Three-coat fluoropolymer or Siliconized polyester.
d. Color: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

4. Panel Coverage: 6 inches (152 mm), 12 inches (305 mm) or 14 inches (356 mm).
5. Panel Height: 0.375 inch (10 mm), 0.44 inch (11 mm), 0.50 inch (13 mm) or 0.625 inch (16 mm).

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch (25 mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Three-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
4. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152 mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

SECTION 074616 - ALUMINUM SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum siding and soffit.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For aluminum siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Research/evaluation reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 25 or 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ALUMINUM SIDING

A. Aluminum Siding: Formed and coated product complying with AAMA 1402.

B. Horizontal Pattern: 8-inch (203-mm) exposure in plain, single-board; beaded-edge, single-board or plain, double, 4-inch (102 mm) board style.

C. Horizontal Pattern: 10-inch (254 mm) exposure in plain, Dutch-lap, double, 5-inch (127-mm) board style.

D. Vertical Pattern: 12-inch (300 mm) exposure in board-and-batten, single-board style.

E. Vertical Pattern: 16-inch (400 mm) exposure in V-grooved, triple, 5-1/3-inch (135 mm) board style.

F. Texture: Smooth or Wood grain.

G. Nominal Thickness: 0.019 inch (0.5 mm) or 0.024 inch (0.6 mm).

H. Insulation: Manufacturer's standard integral insulation panels.

I. Finish: Manufacturer's standard three-coat PVDF, primer and baked-on acrylic or primer and baked-on polyester.

1. Colors: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range of colors.

2.2 ALUMINUM SOFFIT

A. Aluminum Soffit: Formed and coated product complying with AAMA 1402.

B. Pattern: 6-inch (152 mm) exposure in V-grooved, single-board style.

C. Pattern: 10-inch (254 mm) exposure in V-grooved, double, 5-inch (127 mm) board style.

D. Pattern: 12-inch (300 mm) exposure in V-grooved, double, 6-inch (152 mm) board style.

E. Pattern: 16-inch (400 mm) exposure in V-grooved, triple, 5-1/3-inch (135 mm) or quadruple, 4-inch (102 mm) board style.

F. Texture: Smooth or Wood grain.

G. Ventilation: Provide perforated or unperforated soffit unless otherwise indicated.

H. Nominal Thickness: 0.019 inch (0.5 mm) or 0.024 inch (0.6 mm).

I. Finish: Manufacturer's standard three-coat PVDF, primer and baked-on acrylic or primer and baked-on polyester.

1. Colors: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or match adjacent siding.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as or matching color and texture of adjacent siding unless otherwise indicated.

B. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.

1. Texture: Smooth or Wood grain.
2. Nominal Thickness: 0.019 inch (0.5 mm) or 0.024 inch (0.6 mm).
3. Finish: Manufacturer's standard three-coat PVDF, primer and baked-on acrylic primer and baked-on polyester.

C. Colors for Decorative Accessories: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or match adjacent siding.

D. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: Same as aluminum siding, Siliconized polyester coating, same color as siding, High-performance organic finish, same color as siding or Factory-prime coating.

E. Fasteners:

1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
3. For fastening aluminum, use aluminum fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.

B. Install aluminum siding and soffit and related accessories according to AAMA 1402.

1. Install fasteners no more than 24 inches (600 mm) o.c.

C. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

D. Where aluminum siding contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.2 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074616

SECTION 074619 - STEEL SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes steel siding and soffit.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For steel siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Research/evaluation reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 or 50 years from date of Substantial Completion.
2. Warranty Period for Chalking and Fading: 10 or 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL SIDING

A. Steel Siding: Formed product, in continuous lengths without end joints, made from galvanized steel complying with ASTM A653/A653M, G90 (Z275) coating.

B. Horizontal Pattern: 8-inch (203 mm) exposure in plain, single-board or plain, double, 4-inch (102 mm) board style.

C. Horizontal Pattern: 10-inch (254 mm) exposure in plain, Dutch-lap, double, 5-inch (127 mm) board style.

D. Vertical Pattern: 12-inch (300 mm) exposure in board-and-batten, single or V-grooved, double board style.

E. Texture: Smooth or Wood grain.

F. Nominal Thickness: 0.017 inch (0.43 mm) or 0.019 inch (0.5 mm).

G. Finish: Manufacturer's standard primer and heat-fused PVC.

1. Colors: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range of colors.

2.2 STEEL SOFFIT

A. Steel Soffit: Formed product made from galvanized steel complying with ASTM A653/A653M, G90 (Z275) coating.

B. Pattern: 12-inch (300 mm) exposure in board-and-batten, single or V-grooved, double board style.

C. Texture: Smooth or Wood grain.

D. Ventilation: Provide perforated or unperforated soffit unless otherwise indicated.

E. Nominal Thickness: 0.017 inch (0.43 mm) or 0.019 inch (0.5 mm).

F. Finish: Manufacturer's standard primer and heat-fused PVC.

1. Colors: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or match adjacent siding.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as or matching color and texture of adjacent siding unless otherwise indicated.

B. Colors for Decorative Accessories: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or Match adjacent siding.

C. Flashing: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

D. Fasteners:

1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
3. For fastening galvanized steel, use hot-dip galvanized-steel fasteners. Where fasteners are exposed to view, use prefinished galvanized-steel fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

C. Where steel siding contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.2 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074619

SECTION 074624 - WOOD SHINGLE AND SHAKE SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-shingle siding.
2. Wood-shake siding.
3. Wood-shingle-clad panels.
4. Felt weather-resistive barrier.
5. Flexible flashing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Approved by CSSB.

B. Grading Agency Qualifications: An independent testing and inspecting agency recognized by authorities having jurisdiction as qualified to label siding for compliance with referenced grading rules.

1.7 WARRANTY

A. Special Materials Warranty: Manufacturer's warranty administered by CSSB and on CSSB's standard form in which Manufacturer agrees to repair or replace CSSB-labeled products that fail in materials within specified warranty period. Material failures include manufacturing defects that result in leaks.

1. Materials Warranty Period: Limited lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Resistance: Provide wood products that are fire-retardant treated according to AWPA U1, pressure treated in closed vessels under pressures of not less than 50 psig (345 kPa), and as follows:

1. Surface-Burning Characteristics: According to ASTM E84; testing by a qualified testing agency acceptable to authorities having jurisdiction, as follows:

a. Flame-Spread Index: 25 or less.
b. Progressive Combustion: No evidence of significant progressive combustion when the test is continued for an additional 20-minute period.
c. Flame Front: Does not progress more than 10-1/2 feet (3200 mm) beyond the centerline of the burners at any time during the test.
d. Effect of Weathering: No increase in the listed classification when subjected to accelerated weathering according to ASTM D2898 Method A.

2. Product Identification: Attach a label to each bundle of wood products that includes the following:

a. Identification mark of testing agency acceptable to authorities having jurisdiction.
b. Identification of treatment manufacturer, chemical treatment, method of application, purpose of treatment, and warranties available.
c. Species of wood.
d. Flame-spread and smoke-developed indexes.
e. Method of drying after treatment.

f. The words "No increase in the listed classification when subjected to the Standard Rain Test."
g. References to model-code approval.

B. Decay Resistance: Provide wood products that are preservative treated according to AWPA U1, chromated copper arsenate (CCA) pressure treatment; with a minimum of 0.40 lb/cu. ft. (6.4 kg/cu. m) retention.

1. Identification: Attach a label to each bundle of wood products; identify manufacturer and include chemical treatment, method of application, purpose of treatment, and warranties available.

C. Grading Rules: Provide siding that complies with CSSB's grading rules for products indicated.

1. Identification: Attach a label to each bundle of siding that identifies manufacturer, type of product, grade, dimensions, and identification mark of grading agency.

2.2 UNDERCOURSING

A. Cedar Undercoursing Shingles: Smooth-sawn western red cedar shingles.

1. Size: Length matching exposed siding and in manufacturer's standard thickness.
2. Grade: No. 3 or Undercoursing.
3. Finish: Match exposed siding.

2.3 EXPOSED SHINGLE SIDING

A. Rebutted-and-Rejointed Cedar Shingles: Smooth-sawn or Sanded western red cedar shingles.

1. Grade: No. 1 or No. 2.
2. Size: 16 inches (406 mm) long; 0.40 inch (10 mm) thick or 18 inches (457 mm) long; 0.45 inch (11 mm) thick or 24 inches (610 mm) long; 0.50 inch (13 mm) thick at butt.
3. Finish: Unfinished, Semitransparent penetrating stain, oil based, factory applied, Semisolid penetrating stain, oil based, factory applied or Oil-based primer, stain blocking, factory applied.

a. Color: As selected by Architect from manufacturer's full range.

B. Machine-Grooved Cedar Shingles: Rebutted-and-rejointed, machine-grooved, No. 1 grade, smooth-sawn western red cedar shingles.

1. Size: 16 inches (406 mm) long; 0.40 inch (10 mm) thick, 18 inches (457 mm) long; 0.45 inch (11 mm) thick, 24 inches (610 mm) long; 0.50 inch (13 mm) thick at butt.
2. Finish: Unfinished, Semitransparent penetrating stain, oil based, factory applied, Semisolid penetrating stain, oil based, factory applied or Oil-based primer, stain blocking, factory applied.

a. Color: As selected by Architect from manufacturer's full range.

C. Fancy-Butt Cedar Shingles: Clear heartwood red cedar, No. 1 grade, with butt shape indicated.

1. Butt Shape: Diagonal, Half Cove, Diamond, Round, Hexagonal, Octagonal, Arrow Square or Fish Scale.
2. Size: 16 inches (406 mm) or 18 inches (455 mm)] long by 5 inches (127 mm) wide, in manufacturer's standard thickness.
3. Finish: Unfinished, Semitransparent penetrating stain, oil based, factory applied, Semisolid penetrating stain, oil based, factory applied or Oil-based primer, stain blocking, factory applied.

a. Color: As selected by Architect from manufacturer's full range.

2.4 EXPOSED SHAKE SIDING

A. Split Cedar Shakes: Hand-split and resawn western red cedar shakes; split face and sawn back.

1. Grade: Premium or No. 1.
2. Length: 18 inches (457 mm) or 24 inches (610 mm).
3. Thickness: 1/2 inch (13 mm) or 3/4 inch (19 mm) at butt.
4. Finish: Unfinished, Semitransparent penetrating stain, oil based, factory applied Semisolid penetrating stain, oil based, factory applied or Oil-based primer, stain blocking, factory applied.

a. Color: As selected by Architect from manufacturer's full range.

B. Taper-Sawn Cedar Shakes: Western red cedar shakes; sawn both sides.

1. Grade: Premium, No. 1 or No. 2.
2. Length: 18 inches (457 mm) or 24 inches (610 mm).
3. Thickness: 5/8 inch (16 mm) or 3/4 inch (19 mm) at butt.
4. Finish: Unfinished, Semitransparent penetrating stain, oil based, factory applied, Semisolid penetrating stain, oil based, factory applied or Oil-based primer, stain blocking, factory applied.

a. Color: As selected by Architect from manufacturer's full range.

2.5 WOOD-SHINGLE-CLAD PANELS

A. Cedar-Shingle Panels: Clear, vertical-grain, western red cedar shingles bonded with exterior-type adhesives to 5/16-inch (8 mm) thick, 96-inch (2438 mm) long DOC PS 1 Exterior C-D plywood panels; with one shingle course, two shingle courses or three shingle courses per panel.

1. Style: Even butt line, tight spacing, Even butt line, open key way, Staggered butt line or Even butt line, striated texture, tight spacing.
2. Fancy-Butt Style: Diagonal, Half Cove, Diamond, Round, Hexagonal, Octagonal, Arrow, Square or Fish Scale.
3. Exposure: Nominal 4-1/2 inches (114 mm), 5 inches (127 mm), 7 inches (178 mm) per course.

B. Prefabricated Corners: Flush or Add-on type.

C. Special Purpose Panels: Radius panels for inside or outside radii of 48 inches (1219 mm) or more.

D. Finish: Unfinished or Semitransparent penetrating stain, oil based, factory applied.

1. Color: As selected by Architect from manufacturer's full range.

2.6 ACCESSORIES

A. Felt Weather-Resistive Barrier: ASTM D226/D226M, Type II or ASTM D4869/D4869M, Type III, asphalt-saturated organic felt, nonperforated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable rubberized-asphalt compound bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin.

1. Minimum Overall Thickness: 0.020 inch (0.5 mm) or 0.040 inch (1.0 mm).
2. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for applicable substrate.

C. Nails: ASTM F1667, stainless-steel, Type 316, stainless-steel, Type 304, or hot-dip galvanized-steel wire nails, sharp pointed, and of sufficient length to penetrate a minimum of 3/4 inch (19 mm) into sheathing.

1. Shingles: Use box or casing nails.
2. Shakes: Use box nails.
3. Felt Weather-Resistive Barrier: Use roofing nails.
4. Nails in Contact with Metal Flashing: Use nails made from same metal as flashing.

D. Wood-Shingle-Clad Panel Fasteners: As recommended by manufacturer.

E. Cedar Lath Strip: Western red cedar, clear heartwood, a minimum of 1-1/2 inches (38 mm) wide.

PART 3 - EXECUTION

3.1 FELT WEATHER-RESISTIVE BARRIER INSTALLATION

A. General: Comply with felt manufacturer's written installation instructions and CSSB recommendations applicable to products and applications indicated unless more stringent requirements apply.

1. Apply horizontally with a 2-inch (51 mm) overlap and a 6-inch (152 mm) end lap. Wrap around inside and outside corners 4 inches (102 mm).
2. Apply felt to cover vertical flashing with a minimum 4-inch (102 mm) overlap unless otherwise indicated.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.

3.3 SINGLE-COURSED WALLS

A. Install products according to manufacturer's written instructions and recommendations in CSSB's "Exterior and Interior Wall Manual."

B. Starter Undercourse: Install a single course of undercoursing at the base of the wall in a continuous straight line.

C. Exposed Siding: Install starter (first) course of exposed siding over starter undercourse with butts 1/2 inch (13 mm) lower than undercourse butts.

1. Install exposed siding courses with butt lines even, staggered 1 inch (25 mm) or staggered 1-1/2 inches (38 mm)]
2. Interior Corner Treatment: Butted against wood stop or Laced, with flashing behind.
3. Exterior Corner Treatment: Butted against corner boards, Laced or Mitered.

D. Weather Exposure and Spacing:

1. Shingles:

a. Maintain maximum weather exposure of 7 inches (178 mm) for 16-inch (406-mm), 8 inches (203 mm) for 18-inch (457 mm) or 10-1/2 inches (267 mm) for 24-inch (610 mm) long shingles.
b. Install primed shingles with sides abutting or Space shingles 1/8 to 1/4 inch (3 to 6 mm) apart.

2. Shakes:

   a. Maintain weather exposure of 8 inches (203 mm) for 18-inch (457 mm) or 10-1/2 inches (267 mm) for 24-inch (610 mm)long shakes.
   b. Install primed shakes with sides abutting or Space shakes 3/8 to 1/2 inch (10 to 13 mm) apart maximum.

3.4 DOUBLE-COURSED WALLS

A. Install products in continuous straight-line courses according to manufacturer's written instructions and recommendations in CSSB's "Exterior and Interior Wall Manual."

B. Undercourse: Install undercoursing under each course of outercourse. Install starter course of undercourse doubled or over wood lath.

C. Outercourse: Install outercourse of exposed siding with butts 1/2 inch (13 mm) lower than undercourse butts.

1. Interior Corner Treatment: Butted against wood stop or Laced, with flashing behind.
2. Exterior Corner Treatment: Butted against corner boards, Laced or Mitered.

D. Weather Exposure and Spacing:

1. Shingles:

   a. Maintain weather exposure of 12 inches (305 mm) for 16-inch (405 mm), 14 inches (356 mm) for 18-inch (457 mm) or 16 inches (406 mm) for 24-inch (610 mm) long shingles.
   b. Install primed outer shingles with sides abutting or Space outer shingles 1/8 to 1/4 inch (3 to 6 mm) apart.

2. Shakes:

   a. Maintain weather exposure of 14 inches (356 mm) for 18-inch (457 mm) or 18 inches (457 mm) for 24-inch (610 mm) long shakes.
   b. Install primed outer shakes with sides abutting or Space outer shakes 3/8 to 1/2 inch (10 to 13 mm) apart maximum.

3.5 FANCY-BUTT SHINGLES

A. Install fancy-butt shingles in continuous straight-line courses along wall with even butt lines according to manufacturer's written instructions and recommendations in CSSB's "Exterior and Interior Wall Manual." Center each shingle in succeeding courses between the two shingles below it.

1. Install wood lath under first course to match thickness of succeeding courses.
2. Maintain weather exposure of 7-1/2 inches (191 mm).

3. Install primed shingles with sides abutting or Space shingles 1/8 to 1/4 inch (3 to 6 mm) apart.
4. Interior Corner Treatment: Butted against wood stop.
5. Exterior Corner Treatment: Butted against corner boards or Mitered.

3.6 WOOD-SHINGLE-CLAD PANEL INSTALLATION

A. Install wood-shingle-clad-panel products according to manufacturer's written instructions.

END OF SECTION 074624

SECTION 074633 - PLASTIC SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vinyl siding and soffit.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For vinyl siding, include VSI's official certification logo printed on Product Data.

B. Samples: For vinyl siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For vinyl siding Installer.

B. Product certificates.

C. Research/evaluation reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Vinyl Siding Installer Qualifications: A qualified installer who employs a VSI-certified Installer on Project.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 25 or 50 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 VINYL SIDING

A. Vinyl Siding: Integrally colored product complying with ASTM D3679.

B. Vinyl Siding Certification Program: Provide products that are listed in VSI's list of certified products.

C. Horizontal Pattern: 6-1/2- or 7-inch (165- or 178-mm) exposure in beaded-edge, single-board style.

D. Horizontal Pattern: 8-inch (20 -mm) exposure in plain, single-board, double, 4-inch (102 mm) board or triple, 2-2/3-inch (68 mm) board style.

E. Horizontal Pattern: 8-inch (203 mm) exposure in Dutch-lap, double, 4-inch (102 mm) board style.

F. Horizontal Pattern: 9-inch (229 mm) exposure in plain, double, 4-1/2-inch (114 mm) or triple, 3-inch (76-mm) board style.

G. Horizontal Pattern: 9-inch (229 mm) exposure in Dutch-lap, double, 4-1/2-inch (114 mm) board style.

H. Horizontal Pattern: 10-inch (254 mm) exposure in plain, Dutch-lap or double, 5-inch (127 mm) board style.

I. Vertical Pattern: 6-inch (152 mm) exposure in V-grooved, single-board style.

J. Vertical Pattern: 8-inch (203 mm) exposure in beaded-edge, double, 4-inch (102 mm) board style.

K. Vertical Pattern: 10-inch (254 mm) exposure in V-grooved, double, 5-inch (127 mm) board style.

L. Vertical Pattern: 12-inch (300 mm) exposure in V-grooved, double, 6-inch (152 mm) or triple, 4-inch (102 mm)> board style.

M. Shingle Pattern: 48-inch (1200 mm) wide, straight-edge notched, staggered-edge notched, half-round edge or octagon edge sheets with wood-grain texture.

N. Texture: Smooth or Wood grain.

O. Nominal Thickness: 0.040 inch (1.0 mm) or 0.044 inch (1.1 mm).

P. Minimum Profile Depth (Butt Thickness): 1/2 inch (13 mm), 5/8 inch (16 mm) or 3/4 inch (19 mm).

Q. Nailing Hem: Double thickness.

R. Finish: Wood-grain print with clear protective coating containing not less than 70 percent PVDF.

1. Colors: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range of colors.

2.2 VINYL SOFFIT

A. Vinyl Soffit: Integrally colored product complying with ASTM D4477.

B. Vinyl Siding Certification Program: Provide products that are listed in VSI's list of certified products.

C. Pattern: 6-inch (152 mm) exposure in V-grooved, single-board or beaded-edge, triple, 2-inch (51 mm) board style.

D. Pattern: 8-inch (203 mm) exposure in V-grooved, double, 4-inch (102 mm) board style.

E. Pattern: 10-inch (254 mm) exposure in V-grooved, double, 5-inch (127 mm) board style.

F. Pattern: 12-inch (300 mm) exposure in V-grooved, double, 6-inch (152 mm) or triple, 4-inch (102 mm) board style.

G. Texture: Smooth or Wood grain.

H. Ventilation: Provide perforated or unperforated soffit unless otherwise indicated.

I. Nominal Thickness: 0.035 inch (0.9 mm), 0.040 inch (1.0 mm) or 0.044 inch (1.1 mm).

J. Minimum Profile Depth: 1/2 inch (13 mm), 5/8 inch (16 mm) or 3/4 inch (19 mm).

K. Colors: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or match adjacent siding.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories made from same material as or matching color and texture of adjacent siding unless otherwise indicated.

B. Vinyl Accessories: Integrally colored vinyl accessories complying with ASTM D3679 except for wind-load resistance.

1. Texture: Smooth or Wood grain.

C. Colors for Decorative Accessories: As indicated by manufacturer's designations, match Architect's samples, as selected by Architect from manufacturer's full range of colors or match adjacent siding.

D. Flashing: Provide aluminum or stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: Siliconized polyester coating, same color as siding, High-performance organic finish, same color as siding or Factory-prime coating.

E. Fasteners:

1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
3. For fastening vinyl, use aluminum, hot-dip galvanized or stainless-steel fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.

B. Install vinyl siding and soffit and related accessories according to ASTM D4756.

1. Install fasteners for horizontal vinyl siding no more than 16 inches (400 mm) o.c.
2. Install fasteners for vertical vinyl siding no more than 12 inches (300 mm) o.c.

C. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.2 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074633

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fiber-cement siding and soffit.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For fiber-cement siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Research/evaluation reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 25 or 50 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch (8 mm).

D. Horizontal Pattern: Boards 5-1/4 inches (133 mm), 6-1/4 to 6-1/2 inches (159 to 165 mm), 7-1/4 to 7-1/2 inches (184 to 190 mm), 8-1/4 to 8-1/2 inches (210 to 216 mm) or 9-1/4 to 9-1/2 inches (235 to 241 mm) wide in plain or beaded-edge style.

1. Texture: Smooth, Rough sawn or Wood grain.

E. Vertical Pattern: 48-inch (1200 mm) wide sheets with wood-grain texture and grooves 8 inches (203 mm) or 12 inches (300 mm) o.c.

F. Shingle Pattern: 48-inch (1200 mm) wide, straight-edge notched or staggered-edge notched sheets with wood-grain texture.

G. Panel Texture: 48-inch (1200 mm) wide sheets with smooth, stucco or wood-grain texture.

H. Factory Priming: Manufacturer's standard acrylic primer.

2.2 FIBER-CEMENT SOFFIT

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

B. Nominal Thickness: Not less than 5/16 inch (8 mm).

C. Pattern: 12-inch (300 mm), 16-inch (400 mm) or 24-inch (600 mm) wide sheets with smooth or wood-grain texture.

D. Factory Priming: Manufacturer's standard acrylic primer.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

B. Flashing: Provide aluminum or stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: Siliconized polyester coating, High-performance organic finish or Factory-prime coating.

C. Fasteners:

1. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
3. For fastening fiber cement, use hot-dip galvanized or stainless-steel fasteners.

D. Insect Screening for Soffit Vents: Aluminum, 18 by 16 (1.4 by 1.6 mm) mesh or PVC-coated, glass-fiber fabric, 18 by 14 or 18 by 16 (1.4 by 1.8 or 1.4 by 1.6 mm) mesh.

E. Continuous Soffit Vents: Aluminum, hat-channel shape.

1. Net-Free Area: 4 sq. in./linear ft. (280 sq. cm/m), 6 sq. in./linear ft. (420 sq. cm/m) or 8 sq. in./linear ft. (560 sq. cm/m).
2. Finish: Mill finish, White paint or Brown paint.

F. Round Soffit Vents: Stamped aluminum louvered vents, 2 inches (51 mm), 2-1/2 inches (64 mm), 3 inches (76 mm) or 4 inches (102 mm) in diameter.

1. Finish: Mill finish, White paint or Brown paint.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Install fasteners no more than 24 inches (600 mm) o.c. or as directed.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.2 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 075113 - BUILT-UP ASPHALT ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Built-up asphalt roofing.
2. Substrate board.
3. Roof insulation.
4. Cover board.
5. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and roofing terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation-fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer, stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/C3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m)>.
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m)>.

    a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m)>.

    a. Location: As directed in each direction from each building corner.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1, as directed.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency, as directed.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from same manufacturer as roofing membrane or manufacturer approved by roofing membrane manufacturer.

2.3 ROOFING MEMBRANE SHEET MATERIALS

A. Base Sheet: ASTM D6163/D6163M, Type I, Type II, or Type III, SBS-modified asphalt-impregnated and -coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides, as directed.

B. Base Sheet: ASTM D4601/D4601M, Type I or Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

C. Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

D. Base Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

E. Ply Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

F. Cap Sheet: ASTM D3909/D3909M, asphalt-impregnated and -coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface.

2.4 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

B. Backer Sheet: ASTM D4601/D4601M, Type I or Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

D. Backer Sheet: ASTM D6164/D6164M, Type I or II, Grade S, SBS-modified asphalt sheet reinforced with polyester fabric, ASTM D6163/D6163M, Type I or II, Grade S, SBS-modified asphalt sheet reinforced with glass fibers or ASTM D6162/D6162M, Type I or II, Grade S, SBS-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

E. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, polyester reinforced, ASTM D6163/D6163M, Type I or II, Grade G, glass-fiber reinforced or ASTM D6162/D6162M, Type I or II, Grade G, composite polyester reinforced and glass-fiber reinforced, granule-surfaced; suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan as directed.

F. Metal-Foil-Surfaced Flashing Sheet: ASTM D6298, glass-fiber-reinforced, SBS-modified, metal-foil-surfaced asphalt sheet, suitable for application method specified, and as follows:

1. Foil Surfacing: Aluminum, Copper, Stainless steel or Aluminum, fluoropolymer-coated finish, of color and gloss selected by Architect from manufacturer's full range.

G. Smooth-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade S, polyester-reinforced or ASTM D6223/D6223M, Type I or II, Grade S, composite polyester-reinforced and glass-fiber-reinforced, APP-modified asphalt sheet, smooth surfaced, suitable for application method specified.

H. Granule-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade G, polyester-reinforced or ASTM D6223/D6223M, Type I or II, Grade G, composite polyester-reinforced and glass-fiber-reinforced, granule-surfaced, APP-modified asphalt sheet, suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan, as directed.

I. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

J. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.5 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.6 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.

F. Cold-Applied Asphalt Adhesive: ASTM D4479/D4479M, Type I or Type II, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.

G. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent- and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system, base flashings, and aggregate surfacing adhesive.

H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing manufacturer for application.

I. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening built-up roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.

K. Aggregate Surfacing: ASTM D1863/D1863M, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges or crushed slag, free of sharp edges.

L. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.7 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.8 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.6-lb/cu. ft. (26-kg/cu. m) minimum density, 25psi (173kPa) minimum compressive strength or Type V, 3.0-lb/cu. ft. (48-kg/cu. m) minimum density, 100 psi (690 kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578 Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13 psi (90 kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other surface.

1. Facer Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover board to substrate and acceptable to roofing manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

C. Insulation Cant Strips: ASTM C728, perlite insulation board.

D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

E. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry."

F. Tapered Edge Strips: ASTM C728, perlite insulation board.

G. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

H. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

I. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

J. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface finish: Factory primed or Unprimed.

K. Cover Board: ASTM C1325, fiber-mat reinforced cementitious board, 7/16 inch (11 mm) thick.

L. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

M. Joint Tape: 6 or 8 inch (150 or 200 mm) wide, coated, glass fiber.

2.10 COATING MATERIALS

A. Roof Coating: ASTM D1227, Type II, Class 1, mineral-colloid-emulsified, fibered or Class 2, chemically emulsified, filled or fibered asphalt emulsion, asbestos free.

B. Roof Coating: ASTM D1227, Type III, Class 1, mineral-colloid-emulsified or Class 2, chemically emulsified asphalt emulsion, nonfibered.

C. Roof Coating: ASTM D2824/D2824M, Type I, nonfibered or Type III, fibered, asbestos-free aluminum-pigmented asphaltic coating.

D. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D6083.

1. Color: White, Gray or Buff, as directed.

2.11 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition or Polymer-modified, reconstituted solid-rubber, surface-textured, slip-resisting pads, manufactured as a traffic pad for foot traffic and acceptable to roofing manufacturer, 3/8 inch (10 mm), 1/2 inch (13 mm) or 3/4 inch (19 mm) thick, minimum.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm) or as directed.
2. Color: Contrasting with cap sheet.

B. Walkway Cap Sheet Strips: ASTM D6164/D6164M, Type I or II, Grade G, polyester-reinforced, ASTM D6163, Type I or II, Grade G, glass-fiber-reinforced or ASTM D6162, Type I or II, Grade G, composite polyester-reinforced and glass-fiber-reinforced, SBS-modified asphalt sheet; granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches (914 mm by 1524 mm) or as directed.
2. Granule Color: White, Gray or Tan, as directed.

C. Roof Pavers: Heavyweight, hydraulically pressed, concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: As directed.
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum; ASTM C140/C140M.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that minimum concrete drying period recommended by roofing manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.

B. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers."

E. Asphalt Heating:

1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.
2. Circulate asphalt during heating.

a. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.

3. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
4. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
5. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.

a. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing manufacturer's written instructions.

G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install one lapped base sheet course and mechanically fasten to substrate according to roofing membrane manufacturer's written instructions.

D. Nailer Strips: Mechanically fasten 4-inch nominal (89 mm actual), width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:

1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
2. 48 inches (1219 mm) apart for roof slopes greater than 3 inches per 12 inches (3:12).

E. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane with vertical surfaces or angle changes greater than 45 deg (14 deg C).

F. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows, end joints staggered not less than 12 inches (300 mm) in adjacent rows or and with long joints continuous at right angle to flutes of decking.

    a. Retain first subparagraph below when insulation is installed directly over metal decking.
    b. Locate end joints over crests of decking.
    c. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    d. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    e. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    f. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation so that the flow of water is not restricted.

    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
    f. Trim insulation so that water flow of water is unrestricted.

g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

G. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

a. Lap edges a minimum of 2 inches (51 mm), or as recommended by roof membrane manufacturer.
b. Lap ends a minimum of 6 inches (150 mm), or as recommended by roof membrane manufacturer.
c. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
d. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

h. Adhere base layer of insulation to substrate using adhesive as follows:

1) Set base layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set base layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set base layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that the flow of water is not restricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

   a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
   b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
   c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.7 BUILT-UP ROOFING MEMBRANE INSTALLATION

A. Install roofing according to roofing manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing" and as follows:

1. Base Sheet: One or One, installed over sheathing paper.
2. Number of Ply Sheets: Two, Three or Four.
3. Surfacing: Aggregate, Asphalt surfacing or coating or Mineral-granule-surfaced cap sheet.
4. Mineral-granule-surfaced cap sheet is in addition to number of ply sheets specified.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24) or 3/4 inch per 12 inches (1:18), install roofing ply sheets parallel with slope.

1. Backnail roofing ply sheets to nailer strips or substrate according to roofing system manufacturer's written instructions.

D. Coordinate installation of roofing, so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

F. Install lapped base sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:

1. Mechanically fasten to substrate.
2. Spot or strip mop to substrate with hot roofing asphalt.
3. Adhere to substrate in a solid mopping of hot roofing asphalt, using cold-applied asphalt adhesive or using cold-applied polymer-modified asphalt adhesive.

G. Install three or four ply sheets, starting at low point of roof.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.
4. Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.
5. Embed each ply sheet in cold-applied asphalt adhesive applied at a rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.
6. Embed each ply in cold-applied polymer-modified asphalt adhesive applied at a rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.
7. Install ply sheets without wrinkles, tears, and free from air pockets.

H. Cap Sheet: Install lapped granulated cap sheet, starting at low point of roofing.

1. Offset laps from laps of preceding ply sheets, and align cap sheet without stretching.
2. Lap in direction to shed water.
3. Extend cap sheet over and terminate above cants.
4. Embed cap sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing system manufacturer.
5. Embed each ply sheet in cold-applied asphalt adhesive applied at a rate required by roofing system manufacturer.
6. Embed each ply in cold-applied polymer-modified asphalt adhesive applied at a rate required by roofing system manufacturer.

7. Install cap sheet without wrinkles, tears, and free from air pockets.

I. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with 60 lb/100 sq. ft. (3.0 kg/sq. m) of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft. (20 kg/sq. m) or 300 lb/100 sq. ft. (15 kg/sq. m).
2. If aggregate surfacing is delayed, promptly apply glaze coat of hot roofing asphalt at a rate of 10 lb/100 sq. ft. (0.5 kg/sq. m).

J. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with cold-applied polymer-modified asphalt adhesive at a rate recommended by roof system manufacturer. Cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft. (20 kg/sq. m) or 300 lb/100 sq. ft. (15 kg/sq. m).

K. If aggregate surfacing is delayed, promptly apply glaze coat of cold-applied polymer-modified asphalt adhesive at a rate recommended by roof system manufacturer.

L. Glaze coat roofing surface with hot roofing asphalt applied at a rate of 10 to 15 lb/100 sq. ft. (0.5 to 0.75 kg/sq. m).

3.8 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt, cold-applied adhesive or cold-applied polymer-modified asphalt adhesive.
3. Backer Sheet Application: Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt, cold-applied adhesive or cold-applied polymer-modified asphalt adhesive.
4. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C). Apply hot roofing asphalt to back of flashing sheet if recommended by roofing manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing manufacturer.

6. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied polymer-modified adhesive at rate required by roofing manufacturer.
7. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing manufacturer.
8. Flashing Sheet Application: Torch apply flashing sheet to substrate.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above built-up roofing and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install stripping according to roofing system manufacturer's written instructions, where metal flanges and edgings are set on roofing membrane.

1. Flashing Sheet Stripping: Install flashing sheet stripping in a continuous coating of asphalt roofing cement, in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C), and extend onto roofing membrane, in cold-applied adhesive, or in cold-applied polymer-modified adhesive.
2. Flashing Sheet Stripping: Install flashing sheet stripping by heat welding and extend onto roofing membrane.
3. Built-Up Stripping: Install stripping of not fewer than two roofing ply sheets, setting each ply in a continuous coating of asphalt roofing cement, in a solid mopping of hot roofing asphalt, in cold-applied adhesive, or in cold-applied polymer-modified adhesive, and extend onto roofing membrane 4 inches (100 mm) and 6 inches (150 mm), respectively.

F. Roof Drains: Set 30 by 30-inch (760 by 760 mm) and 4-pound (1.8-kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover metal flashing with roofing cap sheet stripping and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing manufacturer's written instructions.

3.9 COATING INSTALLATION

A. Apply coating to roofing membrane and base flashings according to manufacturer's written instructions, by spray, roller, or other suitable application method, to provide a dry film thickness of not less than 20 mils (0.5 mm).

3.10 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Install walkways at following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    f. Locations indicated on Drawings.
    g. As required by roof membrane manufacturer’s warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining pads.
3. Set walkway pads in additional pour coat of hot roofing asphalt, in cold-applied adhesive or in cold-applied polymer-modified adhesive after sweeping away loose aggregate surfacing.

B. Walkway Cap Sheet Strips: Install walkway cap sheet strips, approximately 36 inches (914 mm) wide and in lengths not exceeding 10 feet (3 m), over roofing membrane, using same application method as used for roofing cap sheet. Install walkway cap sheet strips before flood coat and aggregate surface is applied.

1. Install walkways strips at following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    f. Locations indicated on Drawings.
    g. As required by roof membrane manufacturer’s warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining strips.

C. Roof-Paver Walkways: Install walkway roof pavers according to roofing manufacturer's written instructions.

1. Install roof paver walkways at following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer’s warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjacent roof pavers.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing components that do not comply with requirements, repair substrates, and repair or reinstall roofing to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075113

SECTION 075116 - BUILT-UP COAL TAR ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Built-up coal tar roofing.
2. Substrate board.
3. Roof insulation.
4. Cover board.
5. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and built-up terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation-fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer, stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from each building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from same manufacturer as roofing membrane or manufacturer approved by roofing membrane manufacturer.

2.3 ROOFING MEMBRANE SHEET MATERIALS

A. Base Sheet: ASTM D4601/D4601M, Type I or Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

C. Base Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

D. Ply Sheet: ASTM D227/D227M, coal tar-saturated organic felt.

E. Ply Sheet: ASTM D4990, Type I, coal-tar-impregnated, glass-fiber felt with the physical properties of ASTM D2178/D2178M, Type IV or Type VI.

2.4 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D2178/D2178M, Type IV, asphalt-impregnated, glass-fiber felt.

B. Backer Sheet: Roofing manufacturer's standard spun-bonded, nonwoven, polyester-reinforced fabric, of standard color and weight, suitable for application method specified.

C. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, polyester-reinforced, SBS-modified asphalt sheet; granule-surfaced base flashing; suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan, as directed.

D. Polyester Flashing Sheet: Roofing manufacturer's standard asphalt-coated, polyester-reinforced fabric, base flashing, suitable for application method specified.

E. Fabric Termination: Roofing manufacturer's standard polyester cloth, suitable for application and for reinforcing top seal of base flashing.

2.5 BITUMEN MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Coal Tar Primer: ASTM D43/D43M.

C. Coal Tar Pitch: ASTM D450/D450M, Type I.

D. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

E. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.6 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by built-up roofing manufacturer for intended use and compatible with roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.

F. Cold-Applied Asphalt Adhesive: ASTM D4479/D4479M, Type I or Type II, roof system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system and base flashings.

G. Cold-Applied Adhesive: Roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system base flashings.

H. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing system, base flashings, and aggregate surfacing adhesive.

I. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing manufacturer for application.

J. SBS-Modified Asphalt Flashing Cement: Roofing manufacturer's standard, asbestos free, of consistency required for application.

K. Coal Tar Roofing Cement: ASTM D5643/D5643M, coal-tar-based roofing cement, asbestos free.

L. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening built-up roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.

M. Aggregate Surfacing: ASTM D1863/D1863M, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges or crushed slag, free of sharp edges.

N. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.7 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.8 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.

1. Compressive strength: 20 psi (138 kPa) or 25 psi (172 kPa).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other surface.

1. Facer Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

C. Tapered Insulation: Provide factory-tapered insulation boards

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.9 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover board to substrate, and acceptable to roofing manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Insulation Cant Strips: ASTM C728, perlite insulation board.

D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

E. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry."

F. Tapered Edge Strips: ASTM C728, perlite insulation board.

G. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

H. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

I. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

J. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface finish: Factory primed or Unprimed.

K. Cover Board: ASTM C1325, fiber-mat reinforced cementitious board, 7/16 inch (11 mm) thick.

L. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

M. Joint Tape: 6 or 8 inch (150 or 200 mm) wide, coated, glass fiber.

2.10 COATING MATERIALS

A. Roof Coating: ASTM D2824/D2824M, Type I, nonfibered or Type III, fibered, asbestos-free aluminum-pigmented asphaltic coating.

B. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D6083.

1. Color: White, Gray, Buff or as directed.

2.11 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition or Polymer-modified, reconstituted solid-rubber, surface-textured, slip-resisting pads, manufactured as a traffic pad for foot traffic and acceptable to built-up roofing manufacturer, 3/8 inch (10 mm), 1/2 inch (13 mm) or 3/4 inch (19 mm) thick, minimum.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm) or as directed.
2. Color: Contrasting with cap sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested in accordance with ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt or coal tar primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.

B. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers."

E. Bitumen Heating:

1. Heat bitumen to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.
2. Circulate bitumen during heating.
3. Do not raise bitumen temperature above equiviscous temperature range more than one hour before time of application.
4. Do not exceed bitumen manufacturer's recommended temperature limits during bitumen heating.
5. Do not heat bitumen within 25 deg F (14 deg C) of flash point.
6. Discard bitumen maintained for more than four hours at a temperature exceeding 325 deg F (163 deg C) for coal tar pitch or finished blowing temperature for roofing asphalt.
7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing manufacturer's written instructions.

G. Substrate-Joint Penetrations: Prevent coal tar pitch, roofing asphalt, and adhesives from penetrating substrate joints, entering building, or damaging roofing components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install one lapped base sheet course and mechanically fasten to substrate according to roofing membrane manufacturer's written instructions.

D. Nailer Strips: Mechanically fasten 4-inch nominal (89 mm actual) width, wood nailer strips of same thickness as insulation perpendicular to sloped roof deck, spaced 16 feet (4.88 m) apart for roof slopes greater than 1/4 inch per 12 inches (1:48) or 1/2 inch per 12 inches (1:24).

E. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane with vertical surfaces or angle changes greater than 45 degrees.

F. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Retain first subparagraph below when insulation is installed directly over metal decking.
    b. Locate end joints over crests of decking.
    c. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    d. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    e. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    f. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation so that the flow of water is not restricted.

    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
    f. Trim insulation so that water flow of water is unrestricted.
    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    i. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

        1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
        2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
        3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

G. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

    a. Lap edges a minimum of 2 inches (50 mm), or as recommended by roof membrane manufacturer.
    b. Lap ends a minimum of 6 inches (150 mm), or as recommended by roof membrane manufacturer.
    c. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

d. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

   a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

      1) Trim insulation so that the flow of water is not restricted.

   e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

      1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
      2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

   h. Adhere base layer of insulation to substrate using adhesive as follows:

      1) Set base layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
      2) Set base layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
      3) Set base layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

   a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.

b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck or vapor retarder in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that the flow of water is not restricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that the flow of water is not restricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.7 BUILT-UP ROOFING INSTALLATION

A. Install built-up roofing according to roofing manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing" and as follows:

1. Base Sheet: One or One, installed over sheathing paper.
2. Number of Organic Felt Ply Sheets: Two, Three or Four.
3. Number of Glass-Fiber Ply Sheets: One, top ply, Two, Three or Four.
4. Surfacing: Aggregate.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Where roof slope exceeds 1/4 inch per 12 inches (1:48) or 1/2 inch per 12 inches (1:24), install roofing ply sheets parallel with slope.

1. Backnail roofing ply sheets to nailer strips or substrate according to roofing system manufacturer's written instructions.

D. Coordinate installation of roofing, so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

F. Install lapped base sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:

1. Mechanically fasten to substrate.
2. Spot or strip mop to substrate with hot roofing asphalt.
3. Adhere to substrate in a solid mopping of hot roofing asphalt, using cold-applied asphalt adhesive or using cold-applied polymer-modified asphalt adhesive.

G. Monolithic Membrane: Install two, three or four ply sheets, as directed, starting at low point of roof.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate beyond cants.
4. Embed each ply sheet in a solid mopping of hot coal tar pitch to form a uniform membrane without ply sheets touching.

a. Mopping Weights: For interply and other moppings, unless otherwise indicated, apply solid moppings of hot coal tar pitch between ply sheets at a minimum rate of 20 lb/100 sq. ft. (1 kg/sq. m).

H. Composite Membrane: Install two, three or four organic felt ply sheets, as directed, starting at low point of roof.

1. Align organic felt ply sheets without stretching.
2. Shingle side laps of organic felt ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

a. Shingle in direction to shed water.

3. Install finish layer of one lapped coal tar, glass-fiber ply sheet course over shingled organic felt ply sheets, starting at low point of built-up roofing.

a. Offset laps from laps of preceding ply sheets and align coal tar, glass-fiber ply sheet without stretching.
b. Lap in direction to shed water.

4. Extend ply sheets over and terminate beyond cants.
5. Embed each ply sheet in a solid mopping of hot coal tar pitch applied at rate required by roofing system manufacturer, to form a uniform membrane without ply sheets touching.

a. Mopping Weights: For interply and other moppings, unless otherwise indicated, apply solid moppings of hot coal tar pitch between ply sheets at a minimum rate of 20 lb/100 sq. ft. (1 kg/sq. m).

I. Glaze coat roofing membrane surface with hot coal tar pitch applied at a rate of 10 to 15 lb/100 sq. ft. (0.5 to 0.75 kg/sq. m), if aggregate surfacing is not applied immediately.

J. Aggregate Surfacing: After installing and testing roofing membrane, base flashing, and stripping, promptly apply flood coat to roof surface with 70 lb/100 sq. ft. (3.5 kg/sq. m) of hot coal tar pitch. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft. (20 kg/sq. m) or 300 lb/100 sq. ft. (15 kg/sq. m).
2. Sweep loose aggregate from roof surface and apply another flood coat of not less than 85 lb/100 sq. ft. (4.15 kg/sq. m) of hot coal tar pitch. While flood coat is hot and fluid, apply a uniform course of aggregate at the following rate. Sweep away loose aggregate, and fully embed aggregate by lightly rolling into finished roof surface.

a. Aggregate Weight: 300 lb/100 sq. ft. (15 kg/sq. m) or 200 lb/100 sq. ft. (10 kg/sq. m), average.

3.8 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application: Install single backer sheet and adhere to substrate in a solid mopping of hot roofing asphalt, asphalt roofing cement, SBS-modified asphalt roofing cement, cold-applied adhesive or cold-applied polymer-modified asphalt adhesive.
3. Backer Sheet Application: Install two or three backer sheets and adhere to substrate in a solid mopping of hot roofing asphalt or asphalt roofing cement.
4. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C). Apply hot roofing asphalt to back of flashing sheet if recommended by roofing manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in SBS-modified asphalt roofing cement or asphalt roofing cement.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above built-up roofing and 4 inches (100 mm) onto field of built-up roofing.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Securely fasten top termination of base flashing with continuous metal termination bar anchored into substrate.
2. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Apply roof coatings to smooth base flashings according to manufacturer's written instructions, by spray, roller, or other suitable application method.

F. Install stripping according to roofing system manufacturer's written instructions, where metal flanges and edgings are set on roofing membrane.

1. Flashing Sheet Stripping: Install flashing sheet stripping in a cold-applied adhesive or in a solid mopping of hot coal tar pitch, and extend onto roofing membrane.
2. Built-Up Stripping: Install stripping of no fewer than two roofing ply sheets, setting each ply in a continuous coal tar roofing cement or in a solid mopping of hot coal tar pitch, and extend onto roofing membrane 4 inches (100 mm) and 6 inches (150 mm), respectively.

G. Roof Drains: Set 30 by 30-inch (760 by 760 mm) and 4-pound (1.8-kg) lead flashing in bed of asphalt roofing cement on completed built-up roofing.

1. Cover metal flashing with built-up roofing cap sheet stripping, and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of built-up roofing.
2. Clamp built-up roofing, metal flashing, and stripping into roof-drain clamping ring.
3. Flashing Sheet Stripping: Install flashing sheet stripping in cold-applied adhesive or in a solid mopping of hot coal tar pitch, and extend onto roofing membrane.
4. Built-Up Stripping: Install stripping of no fewer than two roofing ply sheets, setting each ply in a continuous coating of coal tar roofing cement or in a solid mopping of hot coal tar pitch, and extend onto roofing membrane 4 inches (100 mm) and 6 inches (150 mm), respectively.

3.9 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Sweep away loose aggregate surfacing, and set walkway pads in additional flood coat of hot coal tar pitch.
2. Install walkways at following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    f. Locations indicated on Drawings.
    g. As required by roof membrane manufacturer?s warranty requirements.

3. Provide 3-inch (76 mm) clearance between adjoining pads.

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing components that do not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075116

SECTION 075213 - ATACTIC-POLYPROPYLENE (APP) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Atactic-polypropylene (APP)-modified bituminous membrane roofing.
2. Hybrid roofing system that combines built-up ply sheets with atactic-polypropylene (APP)-modified bituminous cap sheet.
3. Substrate board.
4. Roof insulation.
5. Cover board.
6. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation-fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Installer shall employ on Project installers and supervisors certified through the NRCA/MRCA Certified Roofing Torch Applicator (CERTA) program.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15, 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from each building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. Energy Star Listing: Roofing system shall be listed on the DOE's "ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

2.3 BASE SHEET MATERIALS

A. APP-Modified Bitumen Polyester Mat Base Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric; smooth surfaced; suitable for torch application method.

B. APP-Modified Bitumen Fiberglass-Mat Base Sheet: ASTM D6509/D6509M, APP-modified asphalt sheet, reinforced with glass fibers; suitable for cold adhesive application method.

C. APP-Modified Bitumen Fiberglass-Mat Base Sheet: ASTM D6509/D6509M, APP-modified asphalt sheet, reinforced with glass fibers; suitable for torch application method.

D. Asphalt-Coated Fiberglass-Mat Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

E. Vented Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

2.4 INTERPLY SHEETS

A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

2.5 ATACTIC-POLYPROPYLENE (AAP) MODIFIED BITUMINOUS CAP SHEET

A. Smooth-Surfaced Roofing Cap Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

B. Granule-Surfaced Roofing Cap Sheet: ASTM D6222/D6222M, Type I or II, Grade G, APP-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

1. Granule Material: Mineral ceramic coated or slate.
2. Granule Color: White, Gray, Tan or as directed.

2.6 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D4601/D4601M, Type I or Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Backer Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet reinforced with polyester fabric, ASTM D6223/D6223M, Type I or II, Grade S, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers or ASTM D6223/D6223M, Type II, Grade S, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

D. Smooth-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet reinforced with polyester fabric, ASTM D6223/D6223M, Type I, Grade S, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers or ASTM D6223/D6223M, Type II, Grade S, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

E. Granule-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade G, APP-modified asphalt sheet reinforced with polyester fabric, ASTM D6223/D6223M, Type I, Grade G, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers or ASTM D6223/D6223M, Type II, Grade G, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers; granule surfaced; suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan, as directed.

F. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

G. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.7 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

D. Metal Termination Bars: Manufacturer's standard, predrilled, stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.

F. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with interply sheets and aggregate surfacing adhesive.

G. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.

H. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

J. Roofing Granules: Ceramic-coated or Slate roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve; color to match roof membrane.

K. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.8 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 3/8 inch (10 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728 perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.9 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m) minimum density, 100-psi (690-kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2 cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other surface.

1. Facer: Type IV cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer: Type V oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer: Type VII glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.10 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

C. Insulation Cant Strips: ASTM C728, perlite insulation board.

D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

E. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry".

F. Tapered Edge Strips: ASTM C728, perlite insulation board.

G. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

H. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

I. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

J. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm)].
2. Surface Finish: Factory primed or Unprimed.

K. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

L. Cover Board: ASTM C1289, Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

2.11 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.12 COATING MATERIALS

A. Roof Coating: ASTM D1227, Type II, Class 1, mineral-colloid-emulsified, fibered or Class 2, chemically emulsified, filled or fibered asphalt emulsion, asbestos free.

B. Roof Coating: ASTM D1227, Type III, Class 1, mineral-colloid-emulsified or Class 2, chemically emulsified asphalt emulsion, nonfibered.

C. Roof Coating: ASTM D2824/D2824M, Type I, nonfibered or Type III, fibered, asbestos-free, aluminum-pigmented asphaltic coating.

D. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D6083.

1. Color: White, Gray, Buff or Tan, as directed.

2.13 WALKWAYS

A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface or Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch (10 mm), 1/2 inch (13 mm) or 3/4 inch (19 mm) thick, minimum.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm).
2. Color: Contrasting with cap sheet.

B. Walkway Backer Strips: ASTM D6222/D6222M, Grade S, Type I or II, APP-modified asphalt sheet reinforced with polyester fabric or ASTM D6223/D6223M, Grade S, Type I or II, APP-modified asphalt sheet reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

1. Size: 36 by 60 inches (914 mm by 1524 mm).

C. Walkway Cap Sheet Strips: ASTM D6222/D6222M, Grade G, Type I or II, APP-modified asphalt sheet (reinforced with polyester fabric) or ASTM D6223/D6223M, Grade G, Type I or II, APP-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches (914 mm by 1524 mm).
2. Granule Material: Mineral ceramic coated or slate.

3. Granule Color: White, Gray or Tan, as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.

B. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in Section 072713 "Modified Bituminous Sheet Air Barriers", [Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers."

E. Asphalt Heating: Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

1. Circulate asphalt during heating.
2. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.
3. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
4. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
5. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
6. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.

3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Nailer Strips: Mechanically fasten 4-inch nominal (89 mm actual) width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:

1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
2. 48 inches (1219 mm) apart for roof slopes greater than 3 inches per 12 inches (3:12).

D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.

E. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows, end joints staggered not less than 12 inches (300 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
f. Trim insulation, so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

F. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

    a. Lap edges a minimum of 2 inches (51 mm), or as recommended by roof membrane manufacturer.
    b. Lap ends a minimum of 6 inches (150 mm), or as recommended by roof membrane manufacturer.
    c. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    d. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation, so that water flow is not restricted.

    e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

    h. Adhere base layer of insulation to substrate using adhesive as follows:

1) Set base layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set base layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set base layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation so that water flow is not restricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

G. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

    1) Trim insulation, so that water flow is not restricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck or vapor retarder in accordance with FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
    2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board, so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.7 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Retain first paragraph below if roof slope exceeds minimum permitted by roofing system manufacturer. Revise minimum roof slope to suit application.

D. Where roof slope exceeds 1/2 inch per 12 inches (1:24) or 3/4 inch per 12 inches (1:18), install roofing sheets parallel with slope.

1. Backnail roofing sheets to nailer strips or substrate according to roofing system manufacturer's written instructions.

E. Coordinate installation of roofing system, so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.8 BASE SHEET INSTALLATION

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

C. Installation of APP-Modified Bitumen Polyester-Mat, APP-Modified Polyester and Fiberglass-Mat or APP-Modified Bitumen Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a uniform coating of cold-applied adhesive.

5. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to wood or wood panel decks.

    a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

7. Install base sheet without wrinkles, rears, and free from air pockets.
8. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (450 mm).
    d. Heat weld end laps, completely bond and seal laps, leaving no voids.
    e. Roll laps with a 20-pound (9-kg) roller.

9. Repair tears and voids in laps and lapped seams not completely sealed.
10. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

D. Installation of Asphalt-Coated Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to wood or wood panel decks.

    a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

5. Adhere to substrate in a solid mopping of hot roofing asphalt or uniform coating of cold-applied adhesive.
6. Install base sheet without wrinkles or tears, and free from air pockets.
7. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
c. Stagger end laps not less than 18 inches (450 mm).
d. Completely bond and seal laps, leaving no voids.

8. Repair tears and voids in laps and lapped seams not completely sealed.

E. Installation of Vented Base Sheet:

1. Mechanically fasten, using mechanical fasteners specifically designed and sized for fastening to applicable substrate or Spot or strip mop to substrate with hot roofing asphalt vented base sheet with vented side down.

a. Fasten vented base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

3.9 INSTALLATION OF INTERPLY SHEETS

A. Install two or three interply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.
4. Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

3.10 APP-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install polymer-modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.

3. Install cap sheet as follows:
4. Adhere to substrate in a uniform coating of cold-applied adhesive.
5. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Install cap sheet without wrinkles or tears, and free from air pockets.
7. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
3. Stagger end laps not less than 18 inches (450 mm).
4. Heat weld end laps, completely bond and seal laps, leaving no voids.
5. Roll laps with a 20 pound (9 kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

3.11 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
    c. Seal all laps.

3. Backer Sheet Application:

    a. Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt or cold-applied adhesive.

b. Seal all laps.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing system manufacturer.
6. Flashing Sheet Application: Torch apply flashing sheet to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30 by 30 inch (760 by 760 mm) and 4-pound (1.8-kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover lead flashing with roofing cap sheet stripping, and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.12 COATING INSTALLATION

A. Apply coating to roofing membrane and base flashings according to manufacturer's written instructions, by spray, roller, or other suitable application method, to provide a dry film thickness of not less than 20 mils (0.5 mm).

3.13 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Install walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Walkway Strips: Install walkway backer and cap sheet strips over roofing membrane using same application method as for roofing cap sheet.

1. Install walkways strips at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining strips.

3.14 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075213

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Hybrid roofing system that combines built-up ply sheets with styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
3. Substrate board.
4. Roof insulation.
5. Cover board.
6. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.

7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

   a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from each building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

2.3 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

B. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for torch application method.

C. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

D. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for torch application method.

E. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

F. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for torch application method.

G. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

H. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for torch application method.

I. SBS-Modified Bitumen Polyester and Fiberglass Mat Base Sheet: ASTM D6162/D6162M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

J. Asphalt-Coated Fiberglass Mat Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

K. Vented Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

2.4 INTERPLY SHEETS

A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

2.5 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

A. Smooth-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

B. Smooth-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for torch application method.

C. Smooth-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

D. Smooth-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for torch application method.

E. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

F. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

G. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

H. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

I. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

J. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

K. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

L. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

M. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type III, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

N. Granule-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

O. Granule-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

P. Granule-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type III, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

Q. Granule-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type III, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

R. Metal-Foil-Surfaced Roofing Cap Sheet: ASTM D6298, metal-foil-surfaced SBS-modified asphalt sheet, reinforced with glass fibers, suitable for application method specified.

1. Foil Surfacing: Aluminum, Copper, Stainless steel or Aluminum, fluoropolymer-coated finish, of color and gloss selected by Architect from manufacturer's full range.

2.6 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D4601/D4601M, Type I or Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Backer Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D6164/D6164M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163/D6163M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with glass fibers or ASTM D6162/D6162M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers, smooth surfaced, suitable for application method specified.

D. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163/D6163M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with glass fibers or ASTM D6162/D6162M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers, granule surfaced, suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan, as directed.

E. Metal-Foil-Surfaced Flashing Sheet: ASTM D6298, glass-fiber-reinforced SBS-modified asphalt sheet, reinforced with glass fibers, metal-foil surfaced, suitable for application method specified, and as follows:

1. Foil Surfacing: Aluminum, Copper, Stainless steel or Aluminum, fluoropolymer-coated finish, of color and gloss selected by Architect from manufacturer's full range.

F. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

G. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.7 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.

F. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with interply sheets and aggregate surfacing adhesive.

G. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.

H. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

J. Roofing Granules: Ceramic-coated or Slate roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36 mm) sieve and 98 percent of mass retained on No. 40 (0.425 mm) sieve; color to match roof membrane.

K. Aggregate Surfacing: ASTM D1863/D1863M, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges or crushed slag, free of sharp edges.

L. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.8 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728 perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.9 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.6-lb/cu. ft. (26-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (8-kg/cu. m) minimum density, 100 psi (690 kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90 kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

a. Base Layer: 1-1/2 inches (38 mm).
b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other surface.

1. Facer Type IV cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer Type V oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer Type VII glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.10 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

C. Insulation Cant Strips: ASTM C728, perlite insulation board.

D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

E. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry".

F. Tapered Edge Strips: ASTM C728, perlite insulation board.

G. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

H. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

I. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

J. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

K. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

L. Cover Board: ASTM C1289, Type II, Class 4, Grade 1, 1/2-inch (13mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

2.11 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.12 WALKWAYS

A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface or Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch (10 mm), 1/2 inch (13 mm) or 3/4 inch (19 mm) thick, minimum.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm).
2. Color: Contrasting with cap sheet.

B. Walkway Cap-Sheet Strips: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with polyester fabric), ASTM D6163/D6163M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with glass fibers) or ASTM D6162/D6162M, Type I or II, Grade G, SBS-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); granule surfaced; suitable for application method specified, and as follows:

1. Size: 36 by 60 inches (914 mm by 1524 mm).
2. Granule Color: White, Gray or Tan, as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 s2. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.

B. Perform fastener-pullout tests according to roof system manufacturer’s recommendations.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers".

E. Asphalt Heating:

1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

a. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

2. Circulate asphalt during heating.
3. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.

a. For cap sheets, comply with cap sheet manufacturer's recommendations.

4. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
5. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
6. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

a. For cap sheets, comply with cap sheet manufacturer's recommendations.

F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Nailer Strips: Mechanically fasten 4-inch nominal (89 mm actual) width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:

1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
2. 48 inches (1219 mm) apart for roof slopes greater than 3 inches per 12 inches (3:12).

D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.

E. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows, end joints staggered not less than 12 inches (300 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
f. Trim insulation, so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

F. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

    a. Lap edges a minimum of 2 inches (51 mm), or as recommended by roof membrane manufacturer.
    b. Lap ends a minimum of 6 inches (150 mm), or as recommended by roof membrane manufacturer.
    c. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    d. Fasten sheathing paper, APP-modified bitumen fiberglass-mat base sheet or asphalt-coated fiberglass-mat base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation, so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

    h. Adhere base layer of insulation to substrate using adhesive as follows:

        1) Set base layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
        2) Set base layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3) Set base layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

G. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows or end joints staggered not less than 12 inches (300 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Adhere base layer of insulation to concrete roof deck or vapor retarder according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board, so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.7 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24) or 3/4 inch per 12 inches (1:18), install roofing membrane sheets parallel with slope.

1. Backnail roofing sheets to nailer strips or substrate according to roofing system manufacturer's written instructions.

D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.8 BASE SHEET INSTALLATION

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

C. Installation of SBS-Modified Bitumen Polyester-Mat, SBS-Modified Fiberglass-Mat or SBS-Modified Bitumen Polyester and Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a uniform coating of cold-applied adhesive.
5. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to wood or wood panel decks.

    a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

7. Install base sheet without wrinkles, rears, and free from air pockets.
8. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).

b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
c. Stagger end laps not less than 18 inches (450 mm).
d. Heat weld end laps or completely bond and seal laps leaving no voids.
e. Roll laps with a 20 pound (9 kg) roller.

9. Repair tears and voids in laps and lapped seams not completely sealed.
10. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

D. Installation of Asphalt-Coated Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to wood or wood panel decks.

   a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

5. Adhere to substrate in a solid mopping of hot roofing asphalt or uniform coating of cold-applied adhesive.
6. Install base sheet without wrinkles or tears, and free from air pockets.
7. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

   a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
   b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
   c. Stagger end laps not less than 18 inches (450 mm).
   d. Completely bond and seal laps, leaving no voids.

8. Repair tears and voids in laps and lapped seams not completely sealed.

E. Installation of Vented Base Sheet:

1. Mechanically fasten, using mechanical fasteners specifically designed and sized for fastening to applicable substrate or Spot or strip mop to substrate with hot roofing asphalt vented base sheet with vented side down.

   a. Fasten vented base sheet according to requirements in FM Approval's RoofNav for specified Windstorm Resistance Classification.
   b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

3.9 INSTALLATION OF INTERPLY SHEETS

A. Install two or three ply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.

3.10 SBS-MODIFIED BITUMINOUS CAP SHEET INSTALLATION

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:

    a. Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.
    b. Adhere to substrate in cold-applied adhesive.
    c. Torch apply to substrate.

        1) Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

4. Install cap sheet without wrinkles or tears, and free from air pockets.
5. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).

3. Stagger end laps not less than 18 inches (450 mm).
4. Heat weld laps or completely bond and seal laps, leaving no voids.
5. Roll laps with a 20 pound (9 kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

F. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with 60 lb/100 sq. ft. (3 kg/sq. m) of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft. (20 kg/sq. m) or 300 lb/100 sq. ft. (15 kg/sq. m).

3.11 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    c. Seal all laps.

3. Backer Sheet Application:

    a. Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    b. Seal all laps.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

6. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing system manufacturer.
7. Flashing Sheet Application: Torch apply flashing sheet to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30-by-30-inch (760-by-760-mm-), 4-pound (1.8 kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover lead flashing with roofing cap-sheet stripping and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.12 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Install walkways at the following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.

e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane, using same application method as used for roofing cap sheet. Install walkway cap sheet strips before flood coat and aggregate surface is applied.

1. Install walkways strips at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer’s warranty requirements.

2. Provide 3-inch (76 mm) clearance between adjoining strips.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 075316 - CHLOROSULFONATE-POLYETHYLENE (CSPE) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered chlorosulfonate-polyethylene (CSPE) roofing system.
2. Mechanically fastened, chlorosulfonate-polyethylene (CSPE) roofing system.
3. Loosely laid and ballasted, chlorosulfonate-polyethylene (CSPE) roofing system.
4. Substrate board.
5. Vapor retarder.
6. Roof insulation.
7. Cover board.
8. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Samples: For the following products:

1. Roof membrane and flashing, of color required.
2. Aggregate surfacing material in gradation and color required.

3. Roof paver, full sized, in each color and texture required.
4. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

   a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Research reports.

C. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15, 20 or 30 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

    a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As direction, lbf/sq. ft. (kPa/sq. m).

    a. Location: In each direction from building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 CHLOROSULFONATE-POLYETHYLENE (CSPE) ROOFING

A. CSPE Sheet: ASTM D5019, Type 1, Grade 2, 45-mil (1.1 mm) thick, reinforced, flexible uncured sheet formed from CSPE, and as follows:

B. Exposed Face Color: White, Blue, Light gray or Tan, as directed.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 45-mil (1.1 mm) thick, reinforced or 55-mil (1.4 mm) thick, nonreinforced CSPE, as recommended by roofing system manufacturer for intended use, of same color as CSPE roof membrane.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Slip Sheet: ASTM D2178/D2178M, Type IV, glass fiber, asphalt-impregnated felt.

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density,25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m), minimum density, 100-psi (690-kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38.1 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13.00-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38.1 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).

2. Thickness:

   a. Base Layer: 1-1/2 inches (38.1 mm).
   b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Facer Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum thickness: 1/4 inch (6.35 mm).
3. Slope:

   a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
   b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

D. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

E. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

F. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

G. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

H. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV or ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

2.8 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone or Crushed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:

1. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
2. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).
3. Size: ASTM D448, Size 3, ranging in size from 1 to 2 inches (25 to 50 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: As directed.
2. Weight: As directed.
3. Compressive Strength: 2500 psi (17 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm), Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
2. Color: Contrasting with roof membrane.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm), Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with no fewer than three tests probes.
    b. Submit test reports within 24 hours after performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers".

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    h. Loosely lay base layer of insulation units over substrate.
    i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
    f. Trim insulation so that water flow is unrestricted.
    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    i. Loosely lay each layer of insulation units over substrate.

j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

a. Fasten slip sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    h. Loosely lay each layer of insulation units over substrate.
    i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

        1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
        2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
        3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Adhere base layer of insulation to concrete roof deck or vapor retarder according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and beneath roof membrane.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing and install according to roofing system manufacturer's written instructions. Unroll roof membrane and allow to relax before installing.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

E. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roof membrane, and weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation. Complete welding of seams within 24 hours of exposing CSPE sheet or before curing of CSPE sheet has begun. Weld seams as follows:

1. Weld Method: Hot air, Solvent or Hot air or solvent, as standard with membrane roofing system manufacturer.
2. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashing.
3. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
4. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of CSPE sheet using fastening plates or metal battens centered within seam, and mechanically fasten CSPE sheet to roof deck.

I. Seams: Clean seam areas, overlap roof membrane, and weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Complete welding of seams within 24 hours of exposing CSPE sheet or before curing of CSPE sheet has begun.
2. Weld seams as follows:

    a. Weld Method: Hot air, Solvent or Hot air or solvent, as standard with roofing system manufacturer.

3. Test lap edges with probe to verify seam weld continuity.
4. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
5. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
6. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 LOOSELY LAID AND BALLASTED ROOFING INSTALLATION

A. Loosely lay roof membrane over area to receive roofing, and install according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Comply with requirements in SPRI RP-4 for System 1, System 2 or System 3.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere perimeter of roof membrane according to requirements in SPRI RP-4.

G. Mechanically fasten or adhere roof membrane at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roof membrane exposed.
2. At corners and perimeters, adhere a second layer of roof membrane.

H. Apply roof membrane with side laps shingled with slope of deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Complete welding of seams within 24 hours of exposing CSPE sheet or before curing of CSPE sheet has begun.
2. Weld seams as follows:

    a. Weld Method: Hot air, Solvent or Hot air or solvent, as standard with roofing system manufacturer.

3. Test lap edges with probe to verify seam weld continuity.
4. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
5. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
6. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

K. Install protection mat over roof membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

L. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roof membrane ballasted at the end of the workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, As directed, at corners, Weight at perimeter, as directed and Weight as directed, elsewhere.

M. Roof-Paver Ballast: Install lightweight or heavyweight roof-paver ballast according to manufacturer's written instructions.

N. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation. Complete welding of seams within 24 hours of exposing CSPE sheet or before curing of CSPE sheet has begun.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

a. Retain one or more subparagraphs below. Revise to suit Project.
b. Perimeter of each rooftop unit.

c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
e. Top and bottom of each roof access ladder.
f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
g. Locations indicated on Drawings.
h. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (150 mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof-paver walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3 inches (75 mm) of space between adjacent roof pavers.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075316

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Mechanically fastened, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
3. Loosely laid and ballasted, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
4. Substrate board.
5. Roof insulation.
6. Cover board.
7. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness if insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Samples: For the following products:

1. Roof membrane and flashings of color required.
2. Aggregate surfacing material in gradation and color required.
3. Roof paver, full sized, in each color and texture required.
4. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **10**, **15**, **20** or **30** years from Date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D4637/D4637M, Type I, nonreinforced, Type II, scrim or fabric internally reinforced or EPDM sheet with factory-applied seam tape.

1. Thickness: 45 mils (1.1 mm), 60 mils (1.5 mm), 75 mils (1.9 mm) or 90 mils (2.2 mm), nominal.
2. Exposed Face Color: Black or White on black.

B. Fabric-Backed EPDM Sheet: ASTM D4637/D4637M, Type III, nonreinforced, EPDM sheet, laminated to a nonwoven polyester fabric backing except at selvages with factory-applied seam tape.

1. Composite Thickness: 90 mils (2.3 mm), 100 mils (2.5 mm), 105 mils (2.7 mm) or 115 mils (2.9 mm), nominal.
2. Exposed Face Color: Black or White on black.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil (1.5-mm) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils (1.4 to 1.5 mm) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

G. Bonding Adhesive: Manufacturer's standard, water based.

H. Modified Asphaltic Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard modified asphalt, asbestos-free, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

I. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

J. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

K. Seaming Material: Single-component, butyl splicing adhesive and splice cleaner, manufacturer's standard, synthetic-rubber polymer primer and 3-inch (75-mm) wide minimum, butyl splice tape with release film or Factory-applied seam tape, width as recommended by manufacturer.

L. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

M. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

N. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

O. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

P. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board; seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25.4 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.5 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m) minimum density, 100-psi (690-kPa) minimum compressive strength square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Facer: Type IV, cellulosic-fiber-insulation-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer: Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

D. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

E. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

F. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board,7/16-inch (11 mm) thick.

G. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13-mm) thick polyisocyanurate, with a minimum compressive strength of 80 psi (551 kPa).

H. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV or ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

2.8 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone or Crushed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:

1. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
2. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).
3. Size: ASTM D448, Size 3, ranging in size from 1 to 2 inches (25 to 50 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: Actual size(s) of pavers, as directed.
2. Weight: As directed.
3. Compressive Strength: 2500 psi (17 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Rubber Roof Pavers: Interlocking, lightweight rubber units, 24 by 24 by 2-1/4 inches (600 by 600 by 57 mm), 6 lb/sq. ft. (30 kg/sq. m); with grooved back for four-way drainage, beveled and doweled; and as follows:

1. Perimeter Securement Strip: Manufacturer's standard coated steel sheet channel, aluminum sheet channel, mill-finish aluminum sheet hold down or coated aluminum sheet hold down, color as selected by Architect, and fasteners.
2. Color: Black, Gray or Terra cotta, as directed.

D. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: Approximately36 by 60 inches (914 by 1524 mm).
2. Color: Contrasting with roof membrane.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

B. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    h. Loosely lay base layer of insulation units over substrate.
    i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
    f. Trim insulation so that water flow is unrestricted.
    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Loosely lay each layer of insulation units over substrate.
j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

a. Fasten slip sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Adhere base layer of insulation to concrete roof deck or vapor retarder according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (305 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss

Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Loosely lay cover board over substrate.
5. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed roofing. Do not apply to splice area of roof membrane.

G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed roof membrane.

H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

I. Apply roof membrane with side laps shingled with slope of roof deck where possible.

J. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

K. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

L. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

M. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

N. Adhere protection sheet over roof membrane at locations indicated.

3.8 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roofing membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

I. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

J. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

K. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

L. In-Splice Attachment: Secure one edge of roof membrane using fastening plates or metal battens centered within splice, and mechanically fasten roof membrane to roof deck. Field splice seam.

M. Through-Membrane Attachment: Secure roofing using fastening plates or metal battens, and mechanically fasten roof membrane to roof deck. Cover battens and fasteners with a continuous cover strip.

N. Adhere protection sheet over roof membrane at locations indicated.

3.9 LOOSELY LAID AND BALLASTED MEMBRANE ROOFING INSTALLATION

A. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Comply with requirements in SPRI RP-4 for System 1, System 2 or System 3.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere perimeter of roof membrane according to requirements in SPRI RP-4.

G. Mechanically fasten or adhere roof membrane at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roof membrane exposed.
2. At corners and perimeters, adhere a second layer of roof membrane

H. Apply roof membrane with side laps shingled with slope of deck where possible.

I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

K. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

L. Leave seams uncovered until inspected by roofing system manufacturer or testing agency.

M. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

N. Adhere protection sheet over roof membrane at locations indicated.

O. Install protection mat over roof membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

P. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roof membrane ballasted at end of workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, weight, as directed, at corners, perimeter, and elsewhere.

Q. Roof-Paver Ballast: Install lightweight or heavyweight roof-paver ballast according to manufacturer's written instructions.

R. Roof-Paver Ballast: Install rubber roof-paver ballast according to manufacturer's written instructions, in locations indicated.

1. Install perimeter paver edge securement.

S. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    f. Locations indicated on Drawings.
    g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (76-mm) clearance between adjoining pads.
3. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof paver walkways at the following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.

f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3 inches (75 mm) of space between adjacent roof pavers.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

SECTION 075416 – KETONE ETHYLENE ESTER (KEE) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ketone ethylene ester (KEE) roofing system.
2. Mechanically fastened, ketone ethylene ester (KEE) roofing system.
3. Loosely laid and ballasted, ketone ethylene ester (KEE) roofing system.
4. Substrate board.
5. Roof insulation.
6. Cover board.
7. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Samples: For the following products:

1. Roof membrane and flashing, of color required.
2. Aggregate surfacing material in gradation and color required.
3. Roof paver full sized in each color and texture required.
4. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15, 20 or 30 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746 or ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 KETONE ETHYLENE ESTER (KEE) ROOFING

A. KEE Sheet: ASTM D6754/D6754M, fabric reinforced and fabric backed.

1. Thickness: 36 mils (0.9 mm), minimum, 45 mils (1.1 mm), nominal, 50 mils (1.3 mm), 60 mils (1.5 mm), nominal or 80 mils (2 mm), nominal.
2. Exposed Face Color: White or Gray.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as KEE sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Slip Sheet: ASTM D2178/D2178M, Type IV, glass fiber, asphalt-impregnated felt.

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m) minimum density, 100-psi (690-kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38.1 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38.1 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

    a. Base Layer: 1-1/2 inches (38.1 mm).
    b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Facer: Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer: Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.

b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

D. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

E. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board, or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

F. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

G. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

H. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV or ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

2.8 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone or crushed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:

1. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
2. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).
3. Size: ASTM D448, Size 3, ranging in size from 1 to 2 inches (25 to 50 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: Size of paver as directed.
2. Weight: Weight or weight range, as directed.
3. Compressive Strength: 2500 psi (17 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range].

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edge or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (610 by 610 mm), Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
2. Color: Contrasting with roof membrane.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (610 by 610 mm), Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with no fewer than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

a. Locate end joints over crests of decking.
b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

    1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay base layer of insulation units over substrate.
i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

    1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
    f. Trim insulation so that water flow is unrestricted.
    g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    i. Loosely lay each layer of insulation units over substrate.
    j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss

Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation over Wood or Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

a. Fasten slip sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Loosely lay base layer of insulation units over substrate.
g. Adhere base layer of insulation to concrete roof deck or vapor retarder according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss

Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roof membrane.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roof membrane and allow to relax before installing.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

C. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of KEE sheet using fastening plates or metal battens centered within seam, and mechanically fasten KEE sheet to roof deck.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity.
2. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
3. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
4. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 LOOSELY LAID AND BALLASTED ROOFING INSTALLATION

A. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Comply with requirements in SPRI RP-4 for System 1, System 2 or System 3.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere perimeter of roofing according to requirements in SPRI RP-4.

G. Mechanically fasten or adhere roof membrane at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roof membrane exposed.
2. At corners and perimeters, adhere a second layer of roof membrane.

H. Apply roof membrane with side laps shingled with slope of deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity.
2. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
3. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.

4. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

K. Install protection mat over roof membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

L. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roofing ballasted at the end of the workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, Weight, at corners, perimeter and elsewhere, as directed.

M. Roof-Paver Ballast: Install lightweight or heavyweight roof-paver ballast according to manufacturer's written instructions.

N. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
   f. Locations indicated on Drawings.
   g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (76-mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof paver walkways at the following locations:

   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
   f. Locations indicated on Drawings.
   g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3 inches (75 mm) of space between adjacent roof pavers.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for

deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075416

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered polyvinyl chloride (PVC) roofing system.
2. Mechanically fastened, polyvinyl chloride (PVC) roofing system.
3. Loosely laid and ballasted, polyvinyl chloride (PVC) roofing system.
4. Substrate board.
5. Vapor retarder.
6. Roof insulation.
7. Cover board.
8. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Samples: For the following products:

1. Roof membrane and flashing, of color required.
2. Aggregate surfacing material in gradation and color required.
3. Roof paver**,** full sized**,** in each color and texture required.
4. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15, 20 or 30 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

D. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from building corner, as directed.

E. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

F. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

G. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75when tested according to CRRC-1.

H. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D4434/D4434M, Type III, fabric reinforced.

1. Thickness: 50 mils (1.27 mm), 60 mils (1.5 mm) or 80 mills (2.0 mm).
2. Exposed Face Color: White or Gray.

B. PVC Sheet: ASTM D4434/D4434M, Type III, fabric reinforced and fabric backed.

1. Membrane Thickness: 50 mils (1.27 mm), 60 mils (1.5 mm) or 80 mils (2.0 mm).
2. Exposed Face Color: White or Gray.

C. PVC Sheet: ASTM D4434/D4434M, Type II, glass-fiber reinforced, felt backed.

1. Thickness: 60 mils (1.5 mm), 72 mils (1.8 mm) or 80 mils (2.0 mm).
2. Exposed Face Color: Copper brown, Evergreen, Lead gray or Patina green.

D. PVC Sheet: ASTM D4434/D4434M, Type II, reinforced, fabric backed.

1. Retain one thickness in "Thickness" Subparagraph below or revise to suit Project. Verify availability with manufacturers.
2. Thickness: 50 mils (1.27 mm), 60 mils (1.5 mm) or 80 mils (2.0 mm).
3. Exposed Face Color: White.

E. PVC Sheet: ASTM D4434/D4434M, Type IV, fabric reinforced.

1. Thickness: 40 mils (1.0 mm).
2. Exposed Face Color: White, Tan, Gray or Dark gray.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard water based.

E. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

F. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

G. Slip Sheet: ASTM D2178/D2178M, Type IV, glass fiber, asphalt-impregnated felt.

H. Slip Sheet: Manufacturer's standard, of thickness required for application.

I. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, sealed coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25.4 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m)] [minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m) minimum density, 100-psi (690-kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm)].

3. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm)].
2. Thickness:

a. Base Layer: 1-1/2 inches (38 mm).
b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Facer: Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer: Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

D. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.

E. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

F. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16-inch (11 mm) thick.

G. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13 mm) thick polyisocyanurate, having a minimum compressive strength of 80 psi (551 kPa).

H. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV] or ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

2.8 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone or crushed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:

1. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
2. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).
3. Size: ASTM D448, Size 3, ranging in size from 1 to 2 inches (25 to 50 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units, grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: As directed.
2. Weight: As directed.
3. Compressive Strength: 2500 psi (17 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
2. Color: Contrasting with roof membrane.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

2. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
3. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with no fewer than three test probes.
    b. Submit test reports within 24 hours of performing tests.

4. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
5. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers." Or Section 072726 "Fluid-Applied Membrane Air Barriers".

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay base layer of insulation units over substrate.
i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
f. Trim insulation so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Loosely lay each layer of insulation units over substrate.
j. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

    a. Fasten slip sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    g. Loosely lay base layer of insulation units over substrate.
    h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

        1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
        2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
c. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
f. Loosely lay base layer of insulation units over substrate.
g. Adhere base layer of insulation to concrete roof deck or vapor retarder according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roof membrane.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel Owner's testing and inspection agency.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 LOOSELY LAID AND BALLASTED ROOFING INSTALLATION

A. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Comply with requirements in SPRI RP-4 for System 1, System 2 or System 3.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere perimeter of roofing according to requirements in SPRI RP-4.

G. Mechanically fasten or adhere roof membrane at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roof membrane exposed.
2. At corners and perimeters, adhere a second layer of roof membrane.

H. Apply roof membrane with side laps shingled with slope of deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashing.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains and securely seal roof membrane in place with clamping ring.

K. Install protection mat over roof membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

L. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roofing ballasted at end of workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, weight at corners, perimeter, and elsewhere, as directed.

M. Roof-Paver Ballast: Install lightweight or heavyweight roof-paver ballast according to manufacturer's written instructions.

N. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (76 mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof paver walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3 inches (75 mm) of space between adjacent roof pavers.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Mechanically fastened, thermoplastic polyolefin (TPO) roofing system.
3. Loosely laid and ballasted, thermoplastic polyolefin (TPO) roofing system.
4. Substrate board.
5. Roof insulation.
6. Cover board.
7. Walkways.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, as directed.

B. Sustainable Design Submittals:

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

D. Samples: For the following products:

1. Roof membrane and flashings, of color required.

2. Aggregate ballast in gradation and color required.
3. Roof paver, full sized, in each color and texture required.
4. Walkway pads or rolls, of color required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

    a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or as directed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15, 20 or 30 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from building corner, as directed.

D. As directed - Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed as directed for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.

2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low or steep slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed TPO sheet.

1. Thickness: 45 mils (1.1 mm), 60 mils (1.5 mm) or 80 mils (2.0 mm), nominal.
2. Exposed Face Color: Black, Gray, Tan or White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard water based.

E. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1396/C1396M, Type X gypsum board.

1. Thickness: 5/8 inch (16 mm).

B. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm) thick.
2. Surface Finish: Factory primed or Unprimed.

C. Substrate Board: ASTM C728, perlite board, seal coated.

1. Thickness: 3/4 inch (19 mm) or 1 inch (25.4 mm).

D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. (23-kg/cu. m) minimum density, 25-psi (173-kPa) minimum compressive strength or Type V, 3.00-lb/cu. ft. (48-kg/cu. m), minimum density, 100-psi (690-kPa) minimum compressive strength, square edged.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

B. Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) minimum density, 13-psi (90-kPa) minimum compressive strength, square edge.

1. Thermal Resistance: R-value of 3.8 per inch (25.4 mm).
2. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

C. Composite Molded (Expanded) Polystyrene Board Insulation: ASTM C578, Type II, 1.35-lb/cu. ft. (22-kg/cu. m), Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) or Type IX, 1.8-lb/cu. ft. (29-kg/cu. m) minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11 mm) thick.
3. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
4. Thickness: As directed.

D. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 or Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm).
    b. Upper Layer: As directed.

E. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Facer: Type IV, cellulosic-fiber-insulating-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Facer: Type V, oriented strand board facer, 7/16 inch (11 mm) thick.
3. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
4. Size: 48 by 48 inches (1219 by 1219 mm) or 48 by 96 inches (1219 by 2438 mm)].
5. Thickness: As directed.

F. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Thickness: 1/4 inch (6 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm).
2. Surface Finish: Factory primed or Unprimed.

E. Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board, 7/16 inch (11 mm) thick.

F. Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1/2-inch (13-mm) thick polyisocyanurate, with a minimum compressive strength of 80 psi (551 kPa).

G. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D312/D312M, Type III or Type IV or ASTM D6152/D6152M, SEBS modified.

B. Asphalt Primer: ASTM D41/D41M.

2.8 BALLAST

A. Aggregate Ballast: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone or crushed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation, of the following size:

1. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).

2. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).
3. Size: ASTM D448, Size 3, ranging in size from 1 to 2 inches (25 to 50 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: As directed.
2. Weight: As directed.
3. Compressive Strength: 500 psi (17 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
2. Color: Contrasting with roof membrane.

B. Walkway Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm). Manufacture pavers to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.

4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three tests probes.
    b. Submit test reports within 24 hours after performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

    a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers".

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

    a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
6. Loosely lay substrate board over roof deck.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay base layer of insulation units over substrate.
i. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Wood or Wood Panel Decking:

1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood or wood panel decks.

   a. Fasten slip sheet according to requirements for specified Windstorm Resistance Classification.
   b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

   a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

      1) Trim insulation so that water flow is unrestricted.

   e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   g. Loosely lay base layer of insulation units over substrate.

3. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood or wood panel decks.

   a. Fasten insulation according to requirements for specified Windstorm Resistance Classification.
   b. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

4. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    h. Loosely lay each layer of insulation units over substrate.
    i. Adhere each layer of insulation to substrate using adhesive according to assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

        1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
        2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
        3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

E. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows or end joints staggered not less than 12 inches (305 mm) in adjacent rows.

    a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Adhere base layer of insulation to concrete roof deck or vapor retarder according to assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (305 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Loosely lay each layer of insulation units over substrate.
i. Adhere each layer of insulation to substrate using adhesive according to assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Loosely lay cover board over substrate.
5. Adhere cover board to substrate using adhesive according to assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and beneath roof membrane.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed roof membrane. Do not apply to splice area of roof membrane.

G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed roof membrane.

H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

I. Apply roof membrane with side laps shingled with slope of roof deck where possible.

J. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

K. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owners testing and inspection agency.

E. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 LOOSELY LAID AND BALLASTED ROOFING INSTALLATION

A. Loosely lay roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Comply with requirements in SPRI RP-4 for System 1, System 2 or System 3.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

E. Accurately align roof membrane, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere perimeter of roof membrane according to requirements in SPRI RP-4.

G. Mechanically fasten or adhere roof membrane at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving roof membrane exposed.
2. At corners and perimeters, adhere a second layer of roof membrane.

H. Apply roof membrane with side laps shingled with slope of deck where possible.

I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

K. Install protection mat over roof membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

L. Aggregate Ballast: Apply uniformly over roof membrane at the rate required by roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to roofing system. Lay ballast as roof membrane is installed, leaving roof membrane ballasted at end of workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, weight at corners, perimeter and elsewhere, as directed.

M. Roof-Paver Ballast: Install lightweight or heavyweight roof-paver ballast according to manufacturer's written instructions.

N. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roof membrane at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roof membrane at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.10 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

    a. Retain one or more subparagraphs below. Revise to suit Project.
    b. Perimeter of each rooftop unit.
    c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    d. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    e. Top and bottom of each roof access ladder.
    f. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    g. Locations indicated on Drawings.
    h. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (76 mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions.

1. Install roof paver walkways at the following locations:

    a. Perimeter of each rooftop unit.
    b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    d. Top and bottom of each roof access ladder.
    e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    f. Locations indicated on Drawings.
    g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3 inches (75 mm) of space between adjacent roof pavers.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 075552.13 – ATACTIC-POLYPROPYLENE (APP) MODIFIED BITUMINOUS PROTECTED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Atactic-polypropylene (APP)-modified bituminous protected membrane roofing.
2. Roof insulation.
3. Ballast.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tie-in with adjoining air barrier.

D. Samples for Verification: For the following products:

1. Ballast in gradation and color indicated.
2. Roof paver full sized in each color and texture required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer, stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or as directed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Installer shall employ on Project installers and supervisors certified through the NRCA/MRCA Certified Roofing Torch Applicator (CERTA) program.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from each building corner, as directed.

D. Approvals' Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roofing pavers shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for roof paver products.

F. Energy Performance: Roof pavers shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components, including roof insulation for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.3 BASE SHEET MATERIALS

A. APP-Modified Bitumen Polyester Mat Base Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric; smooth surfaced; suitable for torch application method.

B. APP-Modified Bitumen Fiberglass-Mat Base Sheet: ASTM D6509/D6509M, APP-modified asphalt sheet, reinforced with glass fibers; suitable for cold adhesive application method.

C. APP-Modified Bitumen Fiberglass-Mat Base Sheet: ASTM D6509/D6509M, APP-modified asphalt sheet, reinforced with glass fibers; suitable for torch application method.

D. Vented Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

2.4 INTERPLY SHEETS

A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

2.5 ATACTIC-POLYPROPYLENE- (AAP-) MODIFIED BITUMINOUS CAP SHEET

A. Smooth-Surfaced Roofing Cap Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

B. Granule-Surfaced Roofing Cap Sheet: ASTM D6222/D6222M, Type I or II, Grade G, APP-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

1. Granule Material: Mineral ceramic coated or slate.
2. Granule Color: White, Gray or Tan, as directed.

C. Granule-Surfaced Roofing Cap Sheet: ASTM D6223/D6223M, Type II, Grade G, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; suitable for cold adhesive application method.

1. Granule Material: Mineral ceramic coated or slate.
2. Granule Color: White, Gray or Tan, as directed.

D. Granule-Surfaced Roofing Cap Sheet: ASTM D6223/D6223M, Type II, Grade G, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; suitable for torch application method.

1. Granule Material: Mineral ceramic coated or slate.
2. Granule Color: White, Gray or Tan.

2.6 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D4601/D4601M, Type I or Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Backer Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric or ASTM D6223/D6223M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

D. Smooth-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade S, APP-modified asphalt sheet, reinforced with polyester fabric, ASTM D6223/D6223M, Type I, Grade S, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers or ASTM D6223/D6223M, Type II, Grade S, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

E. Granule-Surfaced Flashing Sheet: ASTM D6222/D6222M, Type I or II, Grade G, APP-modified asphalt sheet, reinforced with polyester fabric, ASTM D6223/D6223M, Type I, Grade G, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers or ASTM D6223/D6223M, Type II, Grade G, APP-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; granule surfaced; suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan or as directed.

F. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

G. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.7 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

D. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.

E. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing components.

F. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.

G. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

H. Insulation Cant Strips: ASTM C728, perlite insulation board.

I. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

J. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."

K. Separator Sheet: Polyethylene sheet, 4 mils (0.1 mm) thick, minimum.

L. Miscellaneous Accessories: Provide accessories recommended by roofing system manufacturer.

2.8 COATING MATERIALS

A. Roof Coating: ASTM D1227, Type II, Class 1, mineral-colloid-emulsified, fibered or Class 2, chemically emulsified, filled or fibered asphalt emulsion, asbestos free.

B. Roof Coating: ASTM D1227, Type III, Class 1, mineral-colloid-emulsified or Class 2, chemically emulsified asphalt emulsion, nonfibered.

C. Roof Coating: ASTM D2824/D2824M, Type I, nonfibered or Type III, fibered, asbestos-free, aluminum-pigmented asphaltic coating.

D. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D6083.

1. Color: White, Gray or Buff, as directed.

2.9 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.8 lb/cu. ft. (29 kg/cu. m) with drainage channels on bottom side, and with two or four edges rabbeted.

1. Thermal Resistance: R-value of 5.0 per inch (25 mm).
2. Size: 24 by 96 inches (600 by 2438 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm), 2 inches (51 mm) or 3 inches (76 mm).
    b. Upper Layer: As directed.

B. Extruded-Polystyrene Board Insulation: ASTM C578, Type VII, 2.2 lb/cu. ft. (35 kg/cu. m) with drainage channels on bottom side, and with two or four edges rabbeted.

1. Thermal Resistance: R-value of 5.0 per inch (25 mm).
2. Size: 24 by 96 inches (600 by 2438 mm).
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm), 2 inches (51 mm) or 3 inches (76 mm).
    b. Upper Layer: As directed.

2.10 INSULATION ACCESSORIES

A. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

B. Metal Securement System: Perimeter securement flashing and strapping fabricated from 3-inch (76-mm) wide stainless steel, a minimum of 0.031 inch (0.8 mm) thick. Provide fasteners as recommended by mortar-faced insulation manufacturer.

2.11 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.12 BALLAST

A. Aggregate Ballast: Smooth, washed riverbed gravel or other acceptable smooth-faced stone or crushed, washed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation; of the following size:

1. Size: ASTM D448, Size 5, ranging in size from 1/2 to 1 inch (13 to 25 mm).
2. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
3. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 65 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: As directed.
2. Weight: As directed.
3. Compressive Strength: 3000 psi (21 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.
5. Paver Supports: Integral corner pedestals creating a minimum 3/16-inch (5-mm) high ventilation air space.
6. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height or adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm) or 1/8 to 3/16 inch (3 to 5 mm).

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm)] factory cast for use as roof pavers; absorption not greater than 5 percent according to ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm); manufactured to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.
5. Paver Supports: Integral corner pedestals, creating a minimum 3/16-inch (5-mm) high ventilation air space.
6. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height or adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm) or 1/8 to 3/16 inch (3 to 5 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing," assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier, with air barrier specified in Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers".

E. Start installation of roofing in presence of manufacturer's technical personnel and Owner's testing and inspection agency.

F. Where roof slope exceeds 1/2 inch per 12 inches (1:24) or 3/4 inch per 12 inches (1:18), install roofing sheets parallel with slope.

G. Coordinate installation of roofing system, so components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

H. Asphalt Heating: Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

1. Circulate asphalt during heating.
2. Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application.
3. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating.
4. Do not heat roofing asphalt within 25 deg F (14 deg C) of flash point.
5. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
6. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

I. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

J. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 BASE-SHEET INSTALLATION

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Install lapped base-sheet course, extending sheet over and terminating above cants.

1. Install base sheet in a shingle fashion.
2. Adhere to substrate in a uniform coating of cold-applied adhesive.
3. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

4. Install base sheet without wrinkles, tears, or air pockets.
5. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (457 mm).
    d. Heat weld end laps or Completely bond and seal laps leaving no voids.
    e. Roll laps with a 20-pound (9-kg) roller.

6. Repair tears and voids in laps and lapped seams not completely sealed.
7. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

C. Installation of Vented Base Sheet:

1. Spot or strip mop to substrate with hot roofing asphalt vented base sheet, with vented side down.

    a. Fasten vented base sheet according to requirements for specified Windstorm Resistance Classification.
    b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

3.5 INTERPLY SHEET INSTALLATION

A. Install two or three ply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.
4. Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

3.6 APP-MODIFIED BITUMINOUS CAP SHEET INSTALLATION

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:
4. Adhere to substrate in a uniform coating of cold-applied adhesive.
5. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Install cap sheet without wrinkles tears, or air pockets.
7. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
3. Stagger end laps not less than 18 inches (457 mm).
4. Heat weld end laps or Completely bond and seal laps leaving no voids.
5. Roll laps with a 20-pound (9-kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.7 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing at cants in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    c. Seal all laps.

3. Backer Sheet Application:

    a. Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    b. Seal all laps.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement.
6. Flashing Sheet Application: Torch apply flashing sheet to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30-by-30-inch (760-by-760-mm) 4-pound (1.8-kg) lead flashing in bed of asphaltic adhesive on roofing.

1. Cover lead flashing with roofing cap sheet stripping and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of roofing.
2. Clamp roofing, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.8 COATING INSTALLATION

A. Apply coating to base flashings according to manufacturer's written instructions, by spray, roller, or other suitable application method.

3.9 INSULATION INSTALLATION

A. Loosely lay separator sheet over cooled roofing membrane, with minimum 2-inch (51-mm) side laps and 4-inch (100-mm) end laps.

B. Loosely lay insulation over roof membrane, with long joints of insulation in continuous straight lines and with end joints staggered not less than 12 inches (300 mm) between rows.

1. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
2. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
3. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

C. Install upper layer of insulation with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

1. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
2. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
3. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
4. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
5. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Install protection layer over insulation, overlapping edges and ends at least 12 inches (300 mm).

1. Do not lap ends of fabric sheets within 72 inches (1800 mm) of roof perimeter.
2. Extend fabric 2 to 3 inches (51 to 76 mm) above ballast at perimeter and penetrations.
3. Apply additional layer of fabric around penetrations to prevent aggregate from getting between penetration and insulation.
4. Do not cover drains or restrict water flow to drains.

3.10 BALLAST INSTALLATION

A. Install aggregate ballast and roof paver ballast uniformly over protection layer.

B. Spread aggregate to not damage roof membrane or base flashings.

C. Apply ballast as insulation is installed, leaving roof insulated and ballasted at end of workday.

D. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 10 lb/sq. ft. (50 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m)] of Size 5 aggregate.

E. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 10 lb/sq. ft. (50 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): One row of roof pavers a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): One row of roof pavers a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 5 aggregate, 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate) or two rows of roof pavers around perimeter of penetration.

F. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 12 lb/sq. ft. (60 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than thicknesses of 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).

4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate.

G. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 12 lb/sq. ft. (60 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): Two rows of roof pavers a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): Two row of roof pavers a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 4) aggregate, 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate) or two rows of roof pavers around perimeter of penetration.

H. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. (65 kg/sq. m) of Size 2 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate.

I. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. (65 kg/sq. m) of Size 2 aggregate.)
2. Zone 2 (Roof Area Perimeter): Three rows of roof pavers a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).

    a. Mechanically fasten securement strapping to center of first perimeter row of roof pavers closest to edge of roof, using straps running parallel to parapet wall or roof edge.

3. Zone 3 (Roof Area Corners): Two row of roof pavers a distance of "Wind Uplift Resistance" (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).

a. Mechanically fasten securement strapping to center of first perimeter corner row of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 2) aggregate, 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate) or two rows of roof pavers around perimeter of penetration.

J. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. (65 kg/sq. m) of Size 2 aggregate.)
2. Zone 2 (Roof Area Perimeter): Four rows of roof pavers a distance of "Wind Uplift Resistance" (as directed) inside roof edge, but not less than 96 inches (2438 mm).

a. Mechanically fasten securement strapping to center of first two perimeter rows of roof pavers closest to edge of roof, using straps running parallel to parapet wall or roof edge.

3. Zone 3 (Roof Area Corners): Four rows of roof pavers a distance of (as directed) "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).

a. Mechanically fasten securement strapping to center of first two perimeter corner rows of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 2 aggregate, 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate) or two rows of roof pavers around perimeter of penetration.

K. Roof Paver Walkways: Install walkway roof pavers using one row or two rows of roof pavers, loosely laid and butted.

1. Install roof paver walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.

3.11 ROOF PAVER INSTALLATION

A. Interlocking Roof Pavers: Install interlocking roof pavers over roofed area according to manufacturer's written instructions.

B. Install roof pavers over roofed area according to insulation manufacturer's written instructions.

1. Mechanically fasten securement strapping to center of first two perimeter rows and first two perimeter corner rows of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

C. Install roof pavers on pedestals set according to pedestal manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following test:

1. Low-Voltage Electrical Conductance Testing: Testing agency shall survey entire roof area and flashings to locate discontinuity in the roof membrane using an exposed metal electrical loop to create an electrical field tested with hand-held probes.

a. Perform tests before overlying construction is placed.
b. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Determine approximate quantities of components within roofing membrane according to ASTM D3617/D3617M.
2. Examine test specimens for interply voids according to ASTM D3617/D3617M and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075552.13

SECTION 075552.16 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS PROTECTED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous protected membrane roofing.
2. Roof insulation.
3. Ballast.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation, include copy of FM Approvals' RoofNav listing.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tie-in with adjoining air barrier.

D. Samples for Verification: For the following products:

1. Ballast in gradation and color indicated.
2. Roof paver full sized in each color and texture required.

E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Evaluation reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Certified statement from existing roof membrane manufacturer, stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1. Installer shall employ on Project installers and supervisors certified through the NRCA/MRCA Certified Roofing Torch Applicator (CERTA) program.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (Roof Area Corners): As directed, lbf/sq. ft. (kPa/sq. m).

a. Location: In each direction from each building corner, as directed.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-60, Class 1A-75, Class 1A-90, Class 1A-105 or Class 1A-120.
2. Hail-Resistance Rating: MH or SH.

E. ENERGY STAR Listing: Roof pavers shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for roof paver products.

F. Energy Performance: Roof pavers shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

A. Source Limitations: Obtain components, including roof insulation for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.3 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric; smooth surfaced; suitable for cold adhesive or hot asphalt application method.

B. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric; smooth surfaced; suitable for torch application method.

C. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric; smooth surfaced; suitable for cold adhesive or hot asphalt application method.

D. SBS-Modified Bitumen Fiberglass Mat Base Sheet: ASTM D6163/D6163M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric; smooth surfaced; suitable for torch application method.

E. Vented Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

2.4 INTERPLY SHEETS

A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, Type IV or Type VI, asphalt-impregnated, glass-fiber felt.

2.5 STYRENE-BUTADIENE-STYRENE- (SBS-) MODIFIED BITUMINOUS CAP SHEET

A. Cap Sheet: ASTM D6164/D6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric; suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

B. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

C.

1. Granule Color: White, Gray or Tan, as directed.

D. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric; suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

E. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric; suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

F. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric; suitable for cold adhesive or hot asphalt application method.

1. Granule Color: White, Gray or Tan, as directed.

G. Granule-Surfaced Roofing Cap Sheet: ASTM D6163/D6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with fiberglass fabric; suitable for torch application method.

1. Granule Color: White, Gray or Tan, as directed.

2.6 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D4601/D4601M, Type I or Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Backer Sheet: ASTM D2626/D2626M, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D6164/D6164M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163/D6163M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with glass fibers or ASTM D6162/D6162M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; smooth surfaced; suitable for application method specified.

D. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, ASTM D6163/D6163M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with glass fibers or ASTM D6162/D6162M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers; granule surfaced; suitable for application method specified, and as follows:

1. Granule Color: White, Gray or Tan, as directed.

E. SBS-Modified Asphalt Metal-Foil-Surfaced Flashing Sheet: ASTM D6298, metal-foil-surfaced SBS-modified asphalt sheet (reinforced with glass fibers); suitable for application method specified, and as follows:

1. Foil Surfacing: Aluminum, Copper, Stainless steel or Aluminum, fluoropolymer-coated finish, of color and gloss selected by Architect from manufacturer's full range.

F. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

G. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.7 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

D. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.

E. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing components.

F. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.

G. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

H. Insulation Cant Strips: ASTM C728, perlite insulation board.

I. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

J. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."

K. Separator Sheet: Polyethylene sheet, 4 mils (0.1 mm) thick, minimum.

L. Miscellaneous Accessories: Provide accessories recommended by roofing system manufacturer.

2.8 COATING MATERIALS

A. Roof Coating: ASTM D1227, Type II, Class 1, mineral-colloid-emulsified, fibered or Class 2, chemically emulsified, filled or fibered asphalt emulsion, asbestos free.

B. Roof Coating: ASTM D1227, Type III, Class 1, mineral-colloid-emulsified or Class 2, chemically emulsified asphalt emulsion, nonfibered.

C. Roof Coating: ASTM D2824/D2824M, Type I, nonfibered or Type III, fibered, asbestos-free, aluminum-pigmented asphaltic coating.

D. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D6083.

1. Color: White, Gray or Buff, as directed.

2.9 ROOF INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.8 lb/cu. ft. (29 kg/cu. m) with drainage channels on bottom side, and with two or four edges rabbeted.

1. Thermal Resistance: R-value of 5.0 per inch ((25 mm)).
2. Size: 24 by 96 inches (600 by 2438 mm) or 48 by 96 inches (1219 by 2438 mm).
3. Thickness:

a. Base Layer: 1-1/2 inch (38 mm), 2 inches (51 mm) or 3 inches (76 mm).
b. Upper Layer: As directed.

B. Extruded-Polystyrene Board Insulation: ASTM C578, Type VII, 2.2 lb/cu. ft. (35 kg/cu. m) with drainage channels on bottom side, and with two or four edges rabbeted.

1. Thermal Resistance: R-value of 5.0 per inch (25.4 mm).
2. Size: 24 by 96 inches ((600 by 2438 mm).)
3. Thickness:

    a. Base Layer: 1-1/2 inches (38 mm), 2 inches (51 mm) or 3 inches (76 mm).
    b. Upper Layer: As directed.

2.10 INSULATION ACCESSORIES

A. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

B. Metal Securement System: Perimeter securement flashing and strapping fabricated from 3-inch (76-mm) wide stainless steel, a minimum of 0.031 inch (0.8 mm) thick. Provide fasteners as recommended by mortar-faced insulation manufacturer.

2.11 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III, Type IV or Type III or IV as recommended by roofing system manufacturer for application.

C. Roofing Asphalt: ASTM D6152/D6152M, SEBS modified.

2.12 BALLAST

A. Aggregate Ballast: Smooth, washed riverbed gravel or other acceptable smooth-faced stone or crushed, washed gravel or crushed stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation; of the following size:

1. Size: ASTM D448, Size 5, ranging in size from 1/2 to 1 inch (13 to 25 mm).
2. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
3. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 65 mm).

B. Lightweight Roof Pavers: Interlocking, lightweight concrete units; grooved back, with four-way drainage capability; beveled, doweled, or otherwise profiled; and as follows:

1. Size: As directed.

2. Weight: As directed.
3. Compressive Strength: 3000 psi (21 MPa) or 5000 psi (34 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.
5. Paver Supports: Integral corner pedestals creating a minimum 3/16-inch (5-mm) high ventilation air space.
6. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height or adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm) or 1/8 to 3/16 inch (3 to 5 mm).

C. Heavyweight Roof Pavers: Heavyweight, hydraulically pressed concrete units, square edged or with top edges beveled 3/16 inch (5 mm)], factory cast for use as roof pavers; absorption not greater than 5 percent according to ASTM C140/C140M; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm); manufactured to dimensional tolerances of plus or minus 1/16 inch (1.6 mm) in length, height, and thickness.
2. Weight: 18 lb/sq. ft. (90 kg/sq. m) or 22 lb/sq. ft. (110 kg/sq. m).
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum.
4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.
5. Paver Supports: Integral corner pedestals creating a minimum 3/16-inch (5-mm) high ventilation air space.
6. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height or adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm) or 1/8 to 3/16 inch (3 to 5 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 sq. m), or portion thereof, of roof deck, with not less than three test probes.

b. Submit test reports within 24 hours of performing tests.

3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

3.2 PREPARATION

A. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing," FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Coordinate installation and transition of roofing system component serving as an air barrier, with air barrier specified in Section 072713 "Modified Bituminous Sheet Air Barriers", Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" or Section 072726 "Fluid-Applied Membrane Air Barriers".

E. Start installation of roofing in presence of manufacturer's technical personnel and Owner's testing and inspection agency.

F. Where roof slope exceeds 1/2 inch per 12 inches (1:24) or 3/4 inch per 12 inches (1:18), install roofing sheets parallel with slope.

G. Coordinate installation of roofing system, so components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

H. Asphalt Heating:

1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

    a. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

2. Circulate asphalt during heating.
3. Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application.

    a. For cap sheets, comply with cap sheet manufacturer's recommendations.

4. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating.
5. Do not heat roofing asphalt within 25 deg F (14 deg C) of flash point.
6. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

    a. For cap sheets, comply with cap sheet manufacturer's recommendations.

I. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

J. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 BASE-SHEET INSTALLATION

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Installation of SBS-Modified Bitumen Polyester-Mat, SBS-Modified Fiberglass-Mat or SBS-Modified Bitumen Polyester and Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a uniform coating of cold-applied adhesive.
5. Torch apply to substrate.

a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Install base sheet without wrinkles, tears, or air pockets.
7. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (457 mm).
    d. Heat weld end laps or Completely bond and seal laps leaving no voids.
    e. Roll laps with a 20-pound ((9-kg)) roller.

8. Repair tears and voids in laps and lapped seams not completely sealed.
9. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

C. Installation of Asphalt-Coated Fiberglass-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a solid mopping of hot roofing asphalt or uniform coating of cold-applied adhesive.
5. Install base sheet without wrinkles, tears, or air pockets.
6. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (457 mm).
    d. Completely bond and seal laps, leaving no voids.

7. Repair tears and voids in laps and lapped seams not completely sealed.

D. Installation of Vented Base Sheet:

1. Spot or strip mop to substrate with hot roofing asphalt vented base sheet with vented side down.

    a. Fasten vented base sheet according to requirements in for specified Windstorm Resistance Classification.

b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

3.5 INTERPLY SHEET INSTALLATION

A. Install two or three ply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.
4. Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

3.6 SBS-MODIFIED BITUMINOUS CAP SHEET INSTALLATION

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:
4. Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.
5. Adhere to substrate in a uniform coating of cold-applied adhesive.
6. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

7. Install cap sheet without wrinkles, tears, or air pockets.
8. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).

2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
3. Stagger end laps not less than 18 inches (457 mm).
4. Heat weld end laps or completely bond and seal laps leaving no voids.
5. Roll laps with a 20-pound (9-kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.7 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

    a. Mechanically fasten backer sheet to walls or parapets.
    b. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    c. Seal all laps.

3. Backer Sheet Application:

    a. Adhere backer sheet to substrate in a solid mopping of hot roofing asphalt or cold-applied adhesive.
    b. Seal all laps.

4. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.
5. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
6. Flashing Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing system manufacturer.
7. Flashing Sheet Application: Torch apply flashing sheet to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30-by-30-inch (760-by-760-mm), 4-pound (1.8-kg) lead flashing in bed of asphaltic adhesive on roofing.

1. Cover lead flashing with roofing cap sheet stripping and extend a minimum of 4 inches (100 mm) or 6 inches (150 mm) beyond edge of metal flashing onto field of roofing.
2. Clamp roofing, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.8 COATING INSTALLATION

A. Apply coating to base flashings according to manufacturer's written instructions, by spray, roller, or other suitable application method.

3.9 INSULATION INSTALLATION

A. Loosely lay separator sheet over cooled roofing membrane, with minimum 2-inch (51-mm) side laps and 4-inch (100-mm) end laps.

B. Loosely lay insulation over roof membrane, with long joints of insulation in continuous straight lines and with end joints staggered not less than 12 inches (300 mm) between rows.

1. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
2. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
3. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

C. Install upper layer of insulation with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

1. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
2. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
3. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
4. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

5. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Install protection layer over insulation, overlapping edges and ends at least 12 inches (300 mm).

1. Do not lap ends of fabric sheets within 72 inches (1800 mm) of roof perimeter.
2. Extend fabric 2 to 3 inches (51 to 76 mm) above ballast at perimeter and penetrations.
3. Apply additional layer of fabric around penetrations to prevent aggregate from getting between penetration and insulation.
4. Do not cover drains or restrict water flow to drains.

3.10 BALLAST INSTALLATION

A. Install aggregate ballast and roof paver ballast uniformly over protection layer.

B. Spread aggregate to not damage roof membrane or base flashings.

C. Apply ballast as insulation is installed, leaving roof insulated and ballasted at end of workday.

D. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 10 lb/sq. ft. ((50 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate a distance (As directed) for "Wind Uplift Resistance" inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate a distance of (As directed) for "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches ((2438 mm)).
4. Within 48 inches ((1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches ((1219 mm)) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 5 aggregate.

E. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 10 lb/sq. ft. ((50 kg/sq. m) of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): One row of roof pavers a distance of (as directed) from "Wind Uplift Resistance" inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): One row of roof pavers a distance of (as directed) for "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 5 aggregate, 20 lb/sq. ft. ((100 kg/sq. m) of Size 5 aggregate or two rows of roof pavers around perimeter of penetration.

F. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 12 lb/sq. ft. (60 kg/sq. m of Size 5 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate a distance of "Wind Uplift Resistance", (as directed) for inside roof edge, but not less than thicknesses of 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 4 aggregate a distance of "Wind Uplift Resistance", (as directed) in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m)] of Size 4 aggregate.

G. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 12 lb/sq. ft. (60 kg/sq. m) of Size 5 aggregate.
2. Zone 2 (Roof Area Perimeter): Two rows of roof pavers a distance of (as directed) from "Wind Uplift Resistance" for inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): Two row of roof pavers a distance of (as directed) from "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. ((75 kg/sq. m) of Size 4) aggregate or 20 lb/sq. ft. ((100 kg/sq. m) of Size 4 aggregate) or two rows of roof pavers around perimeter of penetration.

H. Install aggregate ballast at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. ((65 kg/sq. m) of Size 2 aggregate.)
2. Zone 2 (Roof Area Perimeter): 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate a distance of (as directed) from "Wind Uplift Resistance" inside roof edge, but not less than 96 inches (2438 mm).
3. Zone 3 (Roof Area Corners): 15 lb/sq. ft. (75 kg/sq. m)] [20 lb/sq. ft. (100 kg/sq. m)] of Size 2 aggregate a distance of (as directed) from "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).
4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) or 20 lb/sq. ft. (100 kg/sq. m) of Size 2 aggregate.

I. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. ((65 kg/sq. m) of Size 2 aggregate.)

2. Zone 2 (Roof Area Perimeter): Three rows of roof pavers a distance of (as directed) from "Wind Uplift Resistance" inside roof edge, but not less than 96 inches (2438 mm).

    a. Mechanically fasten securement strapping to center of first perimeter row of roof pavers closest to edge of roof, using straps running parallel to parapet wall or roof edge.

3. Zone 3 (Roof Area Corners): Two row of roof pavers a distance of (as directed) from "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).

    a. Mechanically fasten securement strapping to center of first perimeter corner row of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches (1219 mm) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 2 aggregate, 20 lb/sq. ft. ((100 kg/sq. m) of Size 2 aggregate) or two rows of roof pavers around perimeter of penetration.

J. Install aggregate ballast and roof pavers at rate required by insulation manufacturer, but not less than the following:

1. Zone 1 (Roof Area Field): 13 lb/sq. ft. ((65 kg/sq. m) of Size 2 aggregate.)
2. Zone 2 (Roof Area Perimeter): Four rows of roof pavers a distance of (as directed) from "Wind Uplift Resistance" inside roof edge, but not less than 96 inches (2438 mm).

    a. Mechanically fasten securement strapping to center of first two perimeter rows of roof pavers closest to edge of roof, using straps running parallel to parapet wall or roof edge.

3. Zone 3 (Roof Area Corners): Four rows of roof pavers a distance of (as directed) from "Wind Uplift Resistance" in each direction form a building corner, but not less than 96 inches (2438 mm).

    a. Mechanically fasten securement strapping to center of first two perimeter corner rows of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

4. Within 48 inches (1219 mm) of roof penetrations, with a penetration being defined as any object projecting above the roof insulation that measures 48 inches ((1219 mm)) or more on any side: 15 lb/sq. ft. (75 kg/sq. m) of Size 2 aggregate, 20 lb/sq. ft. ((100 kg/sq. m) of Size 2 aggregate) or two rows of roof pavers around perimeter of penetration.

K. Roof Paver Walkways: Install walkway roof pavers using one row or two rows of roof pavers, loosely laid and butted.

1. Install roof paver walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.

3.11 ROOF PAVER INSTALLATION

A. Interlocking Roof Pavers: Install interlocking roof pavers over roofed area according to manufacturer's written instructions.

B. Install roof pavers over roofed area according to insulation manufacturer's written instructions.

1. Mechanically fasten securement strapping to center of first two perimeter rows and first two perimeter corner rows of roof pavers in each direction from corner, closest to edge of roof, using straps running parallel to parapet wall or roof edge.

C. Install roof pavers on pedestals set according to pedestal manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following test:

1. Low-Voltage Electrical Conductance Testing: Testing agency shall survey entire roof area and flashings to locate discontinuity in the roof membrane using an exposed metal electrical loop to create an electrical field tested with hand-held probes.

a. Perform tests before overlying construction is placed.
b. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

1) Cost of retesting is Contractor's responsibility.

c. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

1. Determine approximate quantities of components within roofing membrane according to ASTM D3617/D3617M.
2. Examine test specimens for interply voids according to ASTM D3617/D3617M and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Roofing system will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075552.16

SECTION 075556 - FLUID-APPLIED PROTECTED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes reinforced, unreinforced, cold or hot fluid-applied protected membrane roofing.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Apply roofing within the range of ambient and substrate temperatures recommended by roofing system manufacturer. Do not apply roofing to a damp or wet substrate or when temperature is below zero deg F (minus 18 deg C).

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:

1. Corner Uplift Pressure: As directed, lbf/sq. ft. (kPa/sq. m).
2. Perimeter Uplift Pressure: As directed, lbf/sq. ft. (kPa/sq. m).
3. Field-of-Roof Uplift Pressure: As directed, lbf/sq. ft. (kPa/sq. m).

B. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

C. Energy Performance: Roofing system shall have an initial solar reflectance not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

D. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A, Class B or Class C; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 ROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Roofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

2.3 BASE FLASHING SHEET MATERIALS

A. Elastomeric Flashing Sheet: 50-mil (1.3-mm) thick, minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives as follows:

1. Tensile Strength: 1400 psi (9.6 MPa) minimum; ASTM D412, Die C.
2. Elongation: 300 percent minimum; ASTM D412.
3. Tear Resistance: 125 psi (860 kPa) minimum; ASTM D624, Die C.
4. Brittleness: Does not break at minus 30 deg F (16 deg C); ASTM D2137.

B. SBS-Modified Bituminous Flashing Sheet: ASTM D6164/D6164M, Grade G, Type I or Type II, polyester-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified, white, gray or tan, as directed.

C. APP-Modified Bituminous Flashing Sheet: ASTM D6222/D6222M, Grade S, smooth or Grade G, granular surfaced, Type I or Type II, polyester-reinforced, APP-modified asphalt sheet; suitable for application method specified.

1. Granule Color: White, Gray or Tan, as directed.

2.4 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with roofing membrane.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Asphalt Primer: ASTM D41/D41M.

C. Elastomeric Sheet: 50-mil (1.3-mm) thick, minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives as follows:

1. Tensile Strength: 1400 psi (9.6 MPa) minimum; ASTM D412, Die C.
2. Elongation: 300 percent minimum; ASTM D412.
3. Tear Resistance: 125 psi (860 kPa) minimum; ASTM D624, Die C.
4. Brittleness: Does not break at minus 30 deg F (16 deg C); ASTM D2137.

D. Metal Termination Bars: Manufacturer's standard, predrilled, stainless-steel or aluminum termination bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with stainless-steel anchors.

E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric or fiberglass mat.

F. Protection Course: Manufacturer's standard, 80-to-90-mil (2.0-to-2.3-mm) thick, fiberglass-reinforced rubberized-asphalt or modified bituminous sheet.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approved roof insulation.

B. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.8 lb/cu. ft. (29 kg/cu. m) or Type VII, 2.2 lb/cu. ft. (35 kg/cu. m), with two or four edges rabbeted.

C. Extruded-Polystyrene Board Insulation: ASTM C578, Type VI, 1.8 lb/cu. ft. (29 kg/cu. m) or Type VII, 2.2 lb/cu. ft. (35 kg/cu. m), with rabbeted edges and with one side having ribbed drainage channels.

2.6 INSULATION ACCESSORIES

A. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.7 BALLAST

A. Aggregate Ballast: Washed, crushed stone or smooth stone that withstands weather exposure without significant deterioration and does not contribute to membrane degradation; of the following size:

1. Size: ASTM D448, Size 5, ranging in size from 1/2 to 1 inch (13 to 25 mm).
2. Size: ASTM D448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).
3. Size: ASTM D448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).

B. Roof Pavers: Heavyweight, hydraulically pressed, concrete units, square edged or with top edges beveled 3/16 inch (5 mm), factory cast for use as roof pavers; absorption not greater than 5 percent, ASTM C140; no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance, ASTM C67; and as follows:

1. Size: 24 by 24 inches (600 by 600 mm).
2. Weight: As directed.
3. Compressive Strength: 7500 psi (52 MPa) or 6500 psi (45 MPa), minimum; ASTM C140.

4. Colors and Textures: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

C. Roof-Paver Metal Straps: Securement strapping fabricated from stainless steel, a minimum of 3 inches (75 mm) wide by 0.031 inch (0.8 mm) thick with stainless-steel anchors.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.2 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive roofing, including joints and cracks, roof drains, and penetrations, according roofing system manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches (150 mm) on each side of joints and adhere to substrates in a layer of hot fluid-applied, rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.3 BASE FLASHING INSTALLATION

A. Install base flashing at terminations of roofing according to manufacturer's written instructions.

3.4 ROOFING MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

C. Unreinforced Membrane: Apply hot rubberized asphalt to area to receive roofing. Spread hot rubberized asphalt to form a uniform, unreinforced, seamless membrane, 180-mil (4.5-mm) minimum thickness or 180-mil (4.5-mm) average thickness, but not less than 125 mils (3.2 mm) thick.

D. Reinforced Membrane: Apply hot fluid-applied, rubberized asphalt to area to receive roofing. Spread a 90-mil (2.3-mm) thick layer of hot fluid-applied, rubberized asphalt; embed reinforcing fabric, overlapping sheets 2 inches (50 mm); spread another 125-mil (3.2-mm) thick layer of hot fluid-applied, rubberized asphalt to form a uniform, reinforced, seamless membrane, 215 mils (5.5 mm) thick.

E. Apply hot fluid-applied, rubberized asphalt over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

F. Cover membrane with protection course with overlapped joints before membrane is subject to construction traffic.

3.5 INSULATION INSTALLATION

A. Loosely lay board insulation units over roofing membrane, with long joints of insulation in continuous straight lines and with end joints staggered between rows. Abut edges and ends between units.

B. Install one or more layers of insulation to achieve required thickness over roofing membrane. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

1. Where overall insulation thickness is 2 inches (50 mm) or more, install required thickness in two or more layers with joints of each succeeding layer staggered over joints of previous layer a minimum of 6 inches (150 mm) in each direction.

C. Install geotextile fabric over insulation, overlapping edges and ends at least 12 inches (300 mm). Do not lap ends of fabric sheets within 72 inches (1800 mm) of roof perimeter. Extend fabric 2 to 3 inches (50 to 75 mm) above ballast at perimeter and penetrations. Apply additional layer of fabric around penetrations to prevent aggregate from getting between penetration and insulation. Do not cover drains or restrict water flow to drains.

3.6 BALLAST INSTALLATION

A. To roofed area, apply aggregate ballast uniformly over geotextile fabric at rate required by insulation manufacturer, carefully spreading aggregate to not damage roofing membrane and base flashings. Install roof-paver ballast according to insulation manufacturer's written instructions. Apply ballast as insulation is installed, leaving roofing membrane insulated and ballasted at end of workday.

1. Walkway Pavers: Install walkways formed from one row or two rows of roof pavers, loosely laid and butted.

3.7 ROOF-PAVER INSTALLATION

A. Install roof pavers over roofed area according to insulation manufacturer's written instructions.

B. Install roof pavers over roofed area according to insulation manufacturer's written instructions. Mechanically fasten roof-paver metal straps to center of first perimeter and first perimeter corner row of roof pavers.

C. Install roof pavers over roofed area according to insulation manufacturer's written instructions. Mechanically fasten roof-paver metal straps to center of first two perimeters and first two perimeter corner rows of roof pavers.

D. Install roof pavers on pedestals set according to pedestal manufacturer's written instructions.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075556

SECTION 075700 - COATED FOAMED ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spray-applied, coated, polyurethane foam roofing.
2. Walkways.

1.2 DEFINITIONS

A. Applicator: A qualified person employed to apply spray-applied, coated, polyurethane foam roofing.

B. Installer: A qualified firm contracted to install spray-applied, coated, polyurethane foam roofing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As Directed.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Research reports.

C. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified coated-foamed-roofing installer who is approved, authorized, or licensed by coating manufacturer for installation of coating manufacturer's product over polyurethane foam.

1. Engage an installer who participates in and who has fulfilled requirements of the SPFA program for company accreditation as "SPFA PCP Accredited Company Roofing," with individual applicator certification for personnel assigned to work on Project.

B. Comply with recommendations in SPFA AY-104.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace coated foamed roofing that does not comply with requirements or that does not remain watertight within specified warranty period.

1. Warranty Period: Five, 10, 15 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Coated Foamed Roofing System: Obtain coating and polyurethane foam from single source from single manufacturer or coating from single source from single manufacturer and polyurethane foam from single manufacturer acceptable in writing to coating manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Coated foamed roofing shall withstand exposure to weather without failure due to defective manufacture, installation, or other defects in construction. Membrane roofing shall remain watertight.

1. Material Compatibility: Provide polyurethane foam, coatings, substrate board, and auxiliary materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Fire-Test-Response Characteristics: Provide coated foamed roofing with the fire-test-response characteristics indicated, as determined by testing identical systems according to test methods below for deck type and slopes indicated by a qualified testing and inspecting agency that is acceptable to authorities having jurisdiction.

1. Class A, Class B or Class C roof covering according to ASTM E108.
2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 75 or less.

3. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested according to FM 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As directed, lbf/sq. ft. (kPa/sq. m).
2. Zone 2 (Roof Area Perimeter): As directed, lbf/sq. ft. (kPa/sq. m).

    a. Location: From roof edge to inside roof edge, as directed.

3. Zone 3 (roof area corners): As directed, lbf/sq. ft. (kPa/sq. m).

    a. Location: In each direction from building corner, as directed.

D. FM Approvals Listing: Provide roofing system and component materials that comply with requirements in FM Approvals Standard 4450 for steel roof decks and Standard 4470 for roof covers as part of a foamed roofing system and that are listed in Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-60, 75, 90, 105 or 120.
2. Hail-Resistance Classification: MH or SH.

E. Energy Performance: Provide coated foam roofing that is listed on the EPA/DOE's "ENERGY STAR Roof Product List" for low or steep slope roof products.

F. Energy Performance: Provide coated foamed roofing certified and labeled according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

2.3 POLYURETHANE FOAM

A. Polyurethane Foam: Rigid, cellular polyurethane; complying with ASTM C1029, Type III; spray applied, with fire retardants as required, and acceptable to coating manufacturer.

1. In-Place Density: 2.8 to 3.0 lb/cu. ft. (44.9 to 48.1 kg/cu. m); ASTM D1622/D1622M.

2.4 URETHANE COATINGS

A. Urethane Coating: Liquid urethane elastomeric coating system specifically formulated for coating spray-applied polyurethane foam roofing. One-component urethanes shall comply with ASTM D6947/D6947M.

1. Base Coat: One, Two or One or two component urethane.
2. Topcoat: One, Two or One or two component urethane.
    a. Color: White, Gray or Tan, as directed.
    b. Color at Walkways: White, Gray or Tan, as directed.
3. Tensile Strength: 600 psi (4.1 MPa) minimum according to ASTM D2370.
4. Elongation: 350 percent minimum according to ASTM D412 after 1000 hours accelerated weathering according to ASTM D4798/D4798M.
5. Water Absorption: 3 percent maximum by weight according to ASTM D471.
6. Fungal Resistance: Zero rating according to ASTM G21.
7. Tear Resistance: 100 lbf/inch (17.5 kN/m) minimum according to ASTM D624.
8. Low-Temperature Flexibility: Pass 0.5-inch (12.5-mm) mandrel at minus 15 deg F (minus 26 deg C) according to ASTM D522/D522M.
9. Vapor Permeance: Minimum 0.7 perm (40.2 ng/Pa x s x sq. m) or 5.0 perms (286 ng/Pa x s x sq. m) at 20 mils (0.5 mm) thick according to ASTM E96/E96M, Desiccant Method, Procedure A.

2.5 SILICONE COATINGS

A. Silicone Coating: Liquid silicone elastomeric coating system complying with ASTM D6694/D6694M and specifically formulated for coating spray-applied polyurethane foam roofing.

1. Composition: One, Two or One or two component silicone.
2. Topcoat Color: White, Gray or Tan, as directed.
3. Topcoat Color at Walkways: White, Gray or Tan, as directed.
4. Vapor Permeance: Minimum 5.0 perms (286 ng/Pa x s x sq. m) at 20 mils (0.5 mm) thick according to ASTM E96/E96M, Desiccant Method, Procedure A.

2.6 ACRYLIC COATINGS

A. Acrylic Coating: Liquid acrylic elastomeric emulsion coating system specifically formulated for coating spray-applied polyurethane foam roofing.

1. Topcoat Color: White, Gray or Tan, as directed.
2. Topcoat Color at Walkways: White, Gray or Tan.
3. Vapor Permeance: Minimum 5.0 perms (286 ng/Pa x s x sq. m) at 20 mils (0.5 mm) thick according to ASTM E96/E96M, Desiccant Method, Procedure A.

2.7 SUBSTRATE BOARD

A. Thermal Barrier: ASTM C1396/C1396M, gypsum board 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm) thick.

B. Thermal Barrier: Board product tested according to and meeting the requirements of both the Temperature Transmission Fire Test and the Integrity Fire Test of NFPA 275.

C. Thermal Barrier: Water-resistant gypsum board with fiberglass mat laminated to both sides, ASTM C1177/C1177M, 1/2 inch (13 mm) or Type X, 5/8 inch (16 mm).

D. Recover Board and Fasteners: As recommended in writing by polyurethane foam manufacturer and complying with the requirements in Section 070150.19 "Preparation for Re-Roofing."

E. Thermal-Barrier Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals Standard 4470 and designed and sized for fastening thermal barrier to substrate.

2.8 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended in writing by roofing manufacturer for intended use.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Polyurethane-foam manufacturer's standard factory-formulated primer.

C. Vapor Retarder: Fluid applied, Bituminous membrane or as recommended in writing by coated foamed roofing manufacturer.

D. Mineral Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained by No. 40 (0.42-mm) sieve.

1. Color: Buff white, Gray, Green or Red, as directed.

E. Reinforcement: Flexible polyester or fiberglass mat of weight, type, and composition recommended in writing by coating manufacturer for embedment in liquid coating.

F. Walkway Pads: Factory formed of nonwoven PVC strands, porous, UV stabilized, of 5/16-inch (8-mm) nominal thickness and approved by coating manufacturer. Provide pad sizes indicated.

1. Color: Yellow, Gray, Blue, Orange or Green, as directed.

G. Sealant: ASTM C920, Class 25, Use NT, Grade NS, Type M, multicomponent urethane or Type S, one-component, neutral- or acid-curing silicone, and as recommended in writing by coated foamed roofing manufacturer for substrate and joint conditions and for compatibility with roofing materials.

H. Sheet Flashing and Accessories: Types recommended in writing by coated foamed roofing manufacturer, provided at locations indicated and as recommended.

PART 3 - EXECUTION

3.1 SUBSTRATE BOARD

A. General: Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

B. Thermal Barrier: Fasten to top flanges of steel deck according to recommendations in Global's "Approval Guide" and its FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

C. Thermal Barrier: Fasten to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to coated foamed roofing manufacturer's written instructions.

D. Recover Board: Install according to coated foamed roofing manufacturer's written instructions and the requirements in Section 070150.19 "Preparation for Re-Roofing." Fasten through existing roofing to roof structure as indicated. Space fasteners for wind-uplift conditions at Project site or as indicated.

3.2 SURFACE PREPARATION

A. General: Clean and prepare substrate according to coated foamed roofing manufacturer's written instructions. Provide clean, dust-free, dew-free, and dry substrate for coated foamed roofing application.

B. Prepare substrate for re-covering according to Section 070150.19 "Preparation for Re-Roofing" and to coated foamed roofing manufacturer's written instructions.

C. Cover and mask adjoining surfaces not receiving coated foamed roofing to prevent overspray or spillage affecting other construction. Temporarily close off roof drains, removing roof-drain plugs when not doing coated foamed roofing work or when rain is forecast.

D. Prime substrate as recommended in writing by coated foamed roofing manufacturer.

E. Fill, cover, or tape joints and cracks in substrate that exceed a width of 1/4 inch (6 mm). Remove dust and dirt from narrower joints and cracks before applying polyurethane foam.

F. Install vapor retarder according to coated foamed roofing manufacturer's written instructions.

3.3 POLYURETHANE FOAM APPLICATION

A. General: Mix and apply polyurethane foam according to ASTM D5469/D5469M and coated foamed roofing manufacturer's written instructions.

B. Apply polyurethane foam in lift thicknesses of not less than 1/2 inch (13 mm) and not more than 1-1/2 inches (38 mm).

C. Uniformly apply total thickness of polyurethane foam indicated, but not less than 1 inch (25 mm), to a surface tolerance of plus 1/4 inch (6 mm) and no minus.

1. Slope to Drain: Vary thickness uniformly and fill low spots to achieve minimum 1/4-inch-per-foot (1:48) slope to drain unless otherwise indicated.

D. Unless otherwise indicated, extend polyurethane foam at least 4 inches (100 mm) above elevation of adjacent roof field.

E. Surface Finish: Provide finished surface of polyurethane foam within the following range of surface textures as defined by ASTM D5469/D5469M:

1. Texture: Smooth to orange peel, coarse orange peel or verge of popcorn, as directed.

F. Remove and replace polyurethane foam not complying with surface-texture limitations. Remove defective thickness and prepare and reapply polyurethane foam with acceptable, uniform results.

3.4 COATING APPLICATION

A. Apply coating system to polyurethane foam by spray, roller, or other suitable application method according to coating manufacturer's written instructions.

B. Apply base coat and one or more topcoats to obtain a uniform, seamless membrane free of blisters and pinholes. Apply each coat at right angles to preceding coat, using contrasting color tints for successive coats.

1. Urethane Coating: Apply coating system to a minimum dry film thickness recommended in writing by coated foamed roofing manufacturer, of 25 mils (0.64 mm), 30 mils (0.76 mm) or 35 mils (0.89 mm).
2. Silicone Coating: Apply coating system to a minimum dry film thickness recommended in writing by coated foamed roofing manufacturer of 20 mils (0.50 mm), 22 mils (0.56 mm), 26 mils (0.66 mm) or 30 mils (0.76 mm).
3. Acrylic Coating: Apply coating system to a minimum dry film thickness recommended in writing by coated foamed roofing manufacturer of 25 mils (0.64 mm), 28 mils (0.71 mm) or 32 mils (0.81 mm).

C. Height at Terminations: Apply coating system at wall terminations and other vertical surfaces to extend vertically beyond polyurethane foam by a minimum of 4 inches (100 mm).

D. Mineral Granules: Apply mineral granules over wet topcoat, using pressure equipment at the rate of 0.5 lb/sq. ft. (2.45 kg/sq. m). Remove excess granules after topcoat has cured.

E. Sealant: Apply sealant to perimeter and other terminations where indicated on Drawings or required by coated foamed roofing manufacturer.

F. Walkways: Install roof walkways in pattern and locations indicated and as follows:

1. Granule-Coated Walkways: Mask off completed coating adjacent to walkways and apply one or two additional topcoats to achieve a minimum dry film thickness recommended in writing by coated foamed roofing manufacturer. Spread mineral granules uniformly at a rate of 0.5 lb/sq. ft. (2.45 kg/sq. m) into final wet coating. Remove masking and excess granules after topcoat has cured.
2. Fabric-Reinforced, Granule-Coated Walkways: Mask off completed coating adjacent to walkways and apply one additional topcoat to achieve a minimum dry film thickness recommended in writing by coated foamed roofing manufacturer. Lay reinforcing fabric into wet coating and apply another topcoat, completely filling fabric. Spread mineral granules uniformly at a rate of 0.5 lb/sq. ft. (2.45 kg/sq. m) into final wet coating. Remove masking and excess granules after topcoat has cured.
3. Preformed Walkway-Pad Walkways: Adhere walkway pads to substrate with compatible adhesive according to coated foamed roofing manufacturer's written instructions.

G. Cure coatings according to manufacturer's written instructions, taking care to prevent contamination and damage during application stages and curing. Do not permit traffic on uncured coatings.

END OF SECTION 075700

SECTION 076100 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes custom-fabricated, flat-seam, standing-seam or batten-seam sheet metal roofing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" or 061053 "Miscellaneous Rough Carpentry" for wood battens required for batten-seam sheet metal roofing if not specified in this Section.
2. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Roofing sheet metal.
2. Underlayment materials.
3. Fasteners.
4. Sealant tape.
5. Elastomeric sealant.
6. Butyl sealant.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include details for forming, including seams and dimensions.
4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
5. Include details of expansion joints, including showing direction of expansion and contraction from points of fixity.

6. Include details of roof penetrations.
7. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, corners, flashings, and counterflashings.
8. Include details of special conditions.
9. Include details of connections to adjoining work.

D. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Evaluation Reports: For self-adhering, high-temperature sheet underlayment, from ICC-ES.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

B. Special warranties.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 or 10 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, battens, underlayment, and accessories, shall comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.

C. Copper Roofing Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are specified or indicated on Drawings.

D. Energy Performance: Provide sheet metal roofing according to one of the following when tested according to CRRC-1:

1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ROOFING SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); with smooth, flat or embossed surface; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Thickness: Nominal 0.022 (0.56) or 0.028 (0.71) inch (mm) unless otherwise indicated.

a. Batten Caps: Nominal 0.028 inch (0.71 mm) thick.

2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions or seacoast and severe environments.
b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

3. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Sheet: ASTM B209 (ASTM B209M) alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat or embossed surface.

1. Thickness: 0.032 inch (0.81 mm) or 0.040 inch (1.02 mm) unless otherwise indicated.

a. Batten Caps: 0.050 inch (1.27 mm) thick.

2. As-Milled Finish: Mill, One-side bright mill, Standard one-side bright or Standard two-side bright.
3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).
4. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal

surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

5. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.
6. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

D. Copper Sheet: ASTM B370 cold-rolled copper sheet, H00 temper.

1. Weight (Thickness): 16 oz./sq. ft. (0.55 mm thick) or 20 oz./sq. ft. (0.70 mm thick) unless otherwise indicated.

a. Batten Caps: 20 oz./sq. ft. (0.70 mm) thick).

2. Nonpatinated Exposed Finish: Mill.

E. Stainless Steel Sheet: ASTM A240/A240M, Type 304 or Type 316, dead soft, fully annealed; with smooth, flat or embossed surface.

1. Thickness: 0.016 inch (0.40 mm) or 0.019 inch (0.48 mm) unless otherwise indicated.

a. Batten Caps: 0.019 inch (0.48 mm) thick.

2. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled), ASTM A480/A480M, No.2B (bright, cold rolled), ASTM A480/A480M, No.3 (coarse, polished directional satin) or ASTM A480/A480M, No.4 (polished directional satin).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.
c. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.3 UNDERLAYMENT MATERIALS

A. Felts: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over

220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C) or higher.
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.

B. Wood Battens: Lumber according to requirements for nailers for roofing in Section 061000 "Rough Carpentry" or Section 061053 "Miscellaneous Rough Carpentry".

C. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. General:

   a. Exposed Fasteners: Heads matching color of sheet metal roofing, using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of roofing.
   b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
   c. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
5. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

D. Solder:

1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead or with maximum lead content of 0.2 percent.
2. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or with maximum lead content of 0.2 percent.
3. For Stainless Steel: ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.

E. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

F. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.

G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187.

I. Underlayment Adhesive:

1. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.
2. Cold-Applied Polymer-Modified Asphalt Adhesive: Underlayment manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.

2.5 ACCESSORIES

A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.

1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:

a. Metallic-Coated Steel or Aluminum Roofing: 0.0250 (0.64) inch (mm) thick stainless steel.

b. Copper Roofing: 16 (0.55) or 20 (0.70 thick) oz./sq. ft. (mm) copper sheet.
c. Stainless Steel Roofing: 0.0250 (0.64) inch (mm) thick stainless steel.

2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin foam or closed-cell laminated polyethylene; minimum 1-inch (25-mm) thick, flexible-closure strips; cut or premolded to match sheet metal roofing profile. Provide closure strips where necessary to ensure weathertight construction.
5. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 0.018 (0.46) inch (mm)thick.

B. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

C. Roof Curbs: Fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing; with bottom of skirt profiled to match roof panel and seam profiles; with weatherproof top box and integral full-length cricket.

1. Fabricate curb subframing of nominal 0.062 (1.59) inch (mm) thick, angle-, C- or Z-shaped, galvanized-steel or stainless steel sheet.
2. Fabricate curb and subframing to withstand indicated loads of size and height indicated.
3. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
4. Insulate curbs with 1 (25) inch (mm)thick, rigid insulation.
5. Provide treated wood nailers at tops of curbs.

2.6 FABRICATION

A. Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.

1. Flat-Seam Roofing: Form flat-seam panels from metal sheets 20 by 28 inches (508 by 710 mm) with 1/2-inch (13-mm) notched and folded edges.
2. Standing-Seam Roofing: Form standing-seam panels with finished seam height of 1 inch (25 mm), of 1-1/2 inches (38 mm) or as indicated.
3. Batten-Seam Roofing: Form batten-seam panels with edges turned up 2-1/8 inches (54 mm) or as indicated and with 1/2-inch (13-mm) flange turned toward center of pan.

B. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

1. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.
2. Offset transverse seams from each other 12 inches (300 mm) inches (mm)minimum.
3. Fold and cleat eaves and transverse seams in shop.
4. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.

C. Built-In Gutters (Integral Gutters): Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.

1. Fabricate in minimum 96-inch (2400-mm) long sections.
2. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
3. Fabricate gutters with built-in expansion joints.

D. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to SMACNA's "Architectural Sheet Metal Manual."

F. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field measurements for accurate fit before shop fabrication.

1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
2. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

G. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking, that tops of fasteners are flush with surface, and that installation is within flatness tolerances required for finished roofing installation.

B. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

C. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before installation.

3.2 PREPARATION

A. Lay out panel arrangement, and nail battens to wood sheathing, screw battens to wood sheathing or screw battens to metal deck before installation of sheet metal roofing.

1. Space fasteners not more than 18 (460) inches (mm) o.c.

3.3 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal roofing.

1. Install in shingle fashion to shed water, with lapped joints of not less than 4 inches (100 mm).
2. Apply from eave to ridge.
3. Apply on roof not covered by self-adhering sheet underlayment.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Apply from eave to ridge.
2. Apply on roof not covered by self-adhering sheet underlayment.
3. Lap horizontal joints not less than 4 inches (100 mm).
4. Lap end joints not less than 12 inches (300 mm).

C. Self-Adhering High-Temperature Sheet Underlayment:

1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm).
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:

    a. Over entire roof.
    b. Roof perimeter for a distance up from eaves of 24 (600) or 36 (910) inches (mm)beyond interior wall line.
    c. Valleys, from lowest to highest point, for a distance on each side of 18 (460) inches (mm).
    d. Rake edges for a distance of 18 (460) inches (mm).
    e. Hips and ridges for a distance on each side of 12 (300) inches (mm).
    f. Roof-to-wall intersections for a distance from wall of 18 (460) inches (mm).
    g. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 (460) inches (mm).
    h. Below entire area of integral gutters, up from eaves a minimum of 36 (910) inches (mm) beyond interior wall line, but not less than 12 (300) inches (mm) up from ridge side of gutter.
    i. Directional transitions for a distance of 12 (300) inches (mm) in each direction.

D. Install slip sheet, wrinkle free, over underlayment or directly on substrate before installing sheet metal roofing and related flashing.

1. Install in shingle fashion to shed water, with lapped joints of not less than 4 inches (100 mm).

E. Install flashings to cover underlayment, slip sheet or ventilation mat according to requirements in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION, GENERAL

A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing system.
2. Install sheet metal roofing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds or sealant.

3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Provide metal closures at peaks, rake edges, rake walls, eaves and each side of ridge and hip caps.
6. Flash and seal sheet metal roofing with closure strips at eaves, rakes, and perimeter of all openings. Fasten with self-tapping screws.
7. Locate and space fastenings in uniform vertical and horizontal alignment. Predrill panels for fasteners.
8. Install ridge and hip caps as sheet metal roofing work proceeds.
9. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
10. Do not use graphite pencils to mark metal surfaces.

B. Thermal Movement: Rigidly fasten metal roof panels to structure at only one location for each panel.

1. Allow remainder of panel to move freely for thermal expansion and contraction.
2. Point of Fixity: Fasten each panel along a single common line of fixing located at eave, ridge, center of panel length or locations indicated on Drawings.
3. Avoid attaching accessories through roof panels in manner that inhibits thermal movement.

C. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal roofing with bituminous coating where roofing contacts wood, ferrous metal, or cementitious construction.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Fasciae:

1. Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws.
2. Flash and seal sheet metal roofing with closure strips where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

A. Install sheet metal roofing system with lines and corners of exposed units true and accurate.

1. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering metal temper and reflectivity.
2. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
3. Fold back sheet metal to form hem on concealed side of exposed edges unless otherwise indicated.

B. Install cleats to hold sheet metal roofing panels in position.

1. Attach each cleat with at least two fasteners to prevent rotation.
2. Space cleats not more than 12 (300) inches (mm) o.c.
3. Bend tabs over fastener head.
4. Provide expansion-type cleats for roof panels that exceed 30 feet (9.1 m) in length.

C. Seal joints as required for watertight construction. For roofing with 3:12 slopes or less, use cleats at transverse seams.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.
e. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pre-tin edges of sheets with solder to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
2. Do not solder metallic-coated steel or aluminum sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

5. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid flux residue from metal after tinning and soldering.

c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

6. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

E. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

F. Flat-Seam Roofing:

1. Attach flat-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
2. After panels are in place, mallet seams tight and solder.
3. Attach roofing panels with cleats spaced not more than 24 (600) inches (mm) o.c. Lock and solder panels to base flashing.
4. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12 (300) inch (mm) o.c. spacing. Lock panels to edge flashing and solder or apply sealant.

G. Standing-Seam Roofing:

1. Attach standing-seam metal panels to substrate with double-fastened cleats spaced at 12 (300) inches (mm) o.c.
2. Install panels reaching from eave to ridge before moving to adjacent panels.

a. Where transverse joints are required, stagger joints in adjacent panels not less than 48 inches (1200 mm).

3. Before panels are interlocked, apply continuous bead of sealant to top of flange of lower panel.
4. Lock standing seams by folding over twice, so cleat and panel edges are completely engaged.
5. Lock each panel to panel below with soldered or sealed transverse seam.
6. Loose-lock panels at eave edges to continuous cleats and flanges at roof edge at gutters.
7. Loose-lock panels at eave edges to continuous edge flashing exposed 24 inches (600 mm) from roof edge.

a. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12 (305) inch (mm) o.c. spacing.
b. Lock panels to edge flashing.

8. Leave seams upright or Fold over seams after locking at ridges and hips.

H. Batten-Seam Roofing:

1. Attach batten-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
2. Hold cleats in place with battens, and fold edges of cleats over to hold panels.

3. After panels are in place and before batten cap is installed, apply continuous bead of sealant to top of upturned flanges of each panel.
4. Install batten cap covering batten and panel edges, and fold batten cap and panel together, so batten cap and panel edges are completely engaged in seams.
5. Hook each panel to panel below with soldered or sealed transverse seam.
6. Splay upturned edges of panels at a slightly obtuse angle, so pan-bottom width is slightly narrower than space between battens, to provide expansion capability.
7. Close batten ends with metal closures. Fold together with panel edges and end of batten cap.
8. Loose-lock panels at eave edges to continuous cleats and flanges at roof edge at gutters.
9. Loose-lock panels at eave edges to continuous-edge flashing exposed 24 inches (600 mm) from roof edge.

    a. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12 (305) inch (mm) o.c. spacing.
    b. Lock panels to edge flashing.

I. Built-In Gutters:

1. Anchor back edge of gutter with continuous cleat.
2. Provide expansion joints at locations indicated on Drawings, but not less than 50 feet (14 m) on center.
3. Join gutter sections with soldered joints.

    a. Join sections with lapped joints sealed with sealant where required for expansion.

4. Provide for thermal expansion.
5. Slope gutters to drainage points.
6. Provide end closures and seal watertight with sealant.
7. Install self-adhering, high-temperature sheet underlayment inside built-in gutter as indicated on Drawings.

    a. Extend self-adhering, high-temperature sheet underlayment to eave drip edges and beneath roof underlayment.
    b. Lap edges 2 inches (50 mm).
    c. Lap ends 4 inches (100 mm).

3.6 ACCESSORY INSTALLATION

A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion.

1. Coordinate installation with flashings and other components.
2. Install components required for complete sheet metal roofing assembly, including trim, seam covers, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items.

3. Install accessories integral to sheet metal roofing that are specified in Section 076200 "Sheet Metal Flashing and Trim" to comply with that Section's requirements.

B. Flashing and Trim: Comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual."

1. Provide concealed fasteners where possible, and install units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment, where "continuous seal strip" is indicated in SMACNA's "Architectural Sheet Metal Manual" and on Drawings.
5. Install exposed flashing and trim without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
6. Install sheet metal flashing and trim to fit substrates, and to result in waterproof and weather-resistant performance.
7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

    a. Space expansion joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
    b. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep and filled with butyl sealant concealed within joints.
    c. Use lapped expansion joints only where indicated on Drawings.

C. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended in SMACNA's "Architectural Sheet Metal Manual."

D. Roof Curbs: Install flashing around bases where curbs meet sheet metal roofing.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

C. Clean and neutralize flux materials. Clean off excess solder.

D. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076100

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed steep-slope roof sheet metal fabrications.
5. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.

9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

D. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long by actual width.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

B. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction or CC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Special warranty.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 or 10 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install copings or roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

E. FM Approvals Listing: Manufacture and install copings or roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60, Class 1-75, Class 1-90, Class 1-105 or Class 1-120. Identify materials with name of fabricator and design approved by FM Approvals.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

1. Nonpatinated, Exposed Finish: Mill.
2. Prepatinated Copper-Sheet Finish: Dark brown or Verdigris, prepatinated in accordance with ASTM B882.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat or embossed surface.

1. As-Milled Finish: Mill, One-side bright mill, Standard one-side bright or Standard two-side bright.
2. Alclad Finish: Metallurgically bonded surfacing alloy on both sides, forming aluminum sheet with reflective luster.
3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).
4. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

    a. Color: Champagne, Light bronze, Medium bronze, Dark bronze, Black, match Architect's sample or as selected by Architect from full range of industry colors and color densities.
    b. Color Range: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

6. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
    b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal

surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

7. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.
8. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

D. Stainless Steel Sheet: ASTM A240/A240M, Type 304 or Type 316, dead soft, fully annealed; with smooth, flat or embossed surface.

1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled), ASTM A480/A480M, No. 2B (bright, cold rolled), ASTM A480/A480M, No. 3 (coarse, polished directional satin) or ASTM A480/A480M, No. 4 (polished directional satin).

E. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat, Embossed and mill phosphatized for field painting and with manufacturer's standard clear acrylic coating on both sides.
2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

c. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

3. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

F. Lead Sheet: ASTM B749 lead sheet.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:

1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or with maximum lead content of 0.2 percent.
2. For Stainless Steel: ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
3. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead or with maximum lead content of 0.2 percent.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane, polysulfide or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

J. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. Material: Stainless steel, 0.019 inch (0.48 mm) thick, Copper, 16 oz./sq. ft. (0.55 mm thick), Aluminum, 0.024 inch (0.61 mm) thick or Galvanized steel, 0.022 inch (0.56 mm) thick.
2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
3. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Accessories:

    a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

7. Finish: Mill or With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch (2400-mm) long sections.
3. Furnish flat-stock gutter brackets and flat-stock or twisted gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness or dimension indicated on Drawings.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen, Wire-ball downspout strainer or Valley baffles.
6. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:

    a. Copper: 16 oz./sq. ft. (0.55 mm thick).
    b. Aluminum: 0.032 inch (0.81 mm) thick.

c. Stainless Steel: 0.016 inch (0.40 mm) thick.
d. Galvanized Steel: 0.022 inch (0.56 mm) thick.
e. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

7. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:

a. Copper: 16 oz./sq. ft. (0.55 mm thick).
b. Aluminum: 0.040 inch (1.02 mm) thick.
c. Stainless Steel: 0.019 inch (0.48 mm) thick.
d. Galvanized Steel: 0.028 inch (0.71 mm) thick.
e. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

8. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:

a. Copper: 20 oz./sq. ft. (0.68 mm thick).
b. Aluminum: 0.050 inch (1.27 mm) thick.
c. Stainless Steel: 0.025 inch (0.64 mm) thick.
d. Galvanized Steel: 0.034 inch (0.86 mm) thick.
e. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch (0.86 mm) thick.

9. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:

a. Copper: 24 oz./sq. ft. (0.82 mm thick).
b. Aluminum: 0.063 inch (1.60 mm) thick.
c. Stainless Steel: 0.031 inch (0.79 mm) thick.
d. Galvanized Steel: 0.040 inch (1.02 mm) thick.
e. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

10. Gutters with Girth 31 to 35 Inches (790 to 890 mm): Fabricate from the following materials:

a. Copper: 24 oz./sq. ft. (0.82 mm thick).
b. Stainless Steel: 0.038 inch (0.95 mm) thick.
c. Galvanized Steel: 0.052 inch (1.32 mm) thick.
d. Aluminum-Zinc Alloy-Coated Steel: 0.052 inch (1.32 mm) thick.

B. Built-in Gutters:

1. Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.
2. Fabricate in minimum 96-inch (2400-mm) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
3. Fabricate gutters with built-in expansion joints and gutter-end expansion joints at walls.

4. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen, Bronze wire-ball downspout strainer or Wire-ball downspout strainer.
5. Fabricate from the following materials:

    a. Copper: 16 oz./sq. ft. (0.55 mm thick).
    b. Stainless Steel: 0.016 inch (0.40 mm) thick.

C. Downspouts: Fabricate round, rectangular or open-face downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: As directed.
2. Fabricate from the following materials:

    a. Copper: 16 oz./sq. ft. (0.55 mm thick).
    b. Aluminum: 0.024 inch (0.61 mm) thick.
    c. Stainless Steel: 0.016 inch (0.40 mm) thick.
    d. Galvanized Steel: 0.022 inch (0.56 mm) thick.
    e. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch (100-mm) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.
4. Galvanized Steel: 0.028 inch (0.71 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Galvanized Steel: 0.028 inch (0.71 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

F. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.040 inch (1.02 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch (2400-mm) long, but not exceeding 12-foot (3.6-m) long sections. Furnish with 6-inch (150-mm) wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Fabricate from the following materials:

    a. Copper: 20 oz./sq. ft. (0.68 mm thick).
    b. Aluminum: 0.050 inch (1.27 mm) thick.
    c. Stainless Steel: 0.019 inch (0.48 mm) thick.
    d. Galvanized Steel: 0.028 inch (0.71 mm) thick.
    e. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

B. Copings: Fabricate in minimum 96-inch (2400-mm) long, but not exceeding 12-foot (3.6-m) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal or solder or weld watertight. Shop fabricate interior and exterior corners.

1. Fabricate from the following materials:

    a. Copper: 24 oz./sq. ft. (0.82 mm thick).
    b. Aluminum: 0.050 inch (1.27 mm) thick.
    c. Stainless Steel: 0.025 inch (0.64 mm) thick.
    d. Galvanized Steel: 0.040 inch (1.02 mm) thick.
    e. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.

C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 20 oz./sq. ft. (0.68 mm thick).
2. Aluminum: 0.040 inch (1.02 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.
4. Galvanized Steel: 0.028 inch (0.71 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.
4. Galvanized Steel: 0.022 inch (0.56 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Galvanized Steel: 0.028 inch (0.71 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
5. Lead: 4 lb (1.8 kg).

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Copper: 12 oz./sq. ft. (0.41 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Galvanized Steel: 0.022 inch (0.56 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

B. Valley Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Galvanized Steel: 0.028 inch (0.71 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

C. Drip Edges: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Galvanized Steel: 0.022 inch (0.56 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

D. Eave, Rake**,** Ridge, and Hip Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Galvanized Steel: 0.022 inch (0.56 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch (2400-mm) long, but not exceeding 12-foot (3.6-m) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch (50-mm) high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch (50-mm) high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Galvanized Steel: 0.022 inch (0.56 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.040 inch (1.02 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.
4. Galvanized Steel: 0.028 inch (0.71 mm) thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches (100 mm).
2. Lap end joints not less than 12 inches (300 mm).

C. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

D. Install slip sheet, wrinkle free, over underlayment or directly on substrate before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches (100 mm).

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds or sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws or substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Stainless Steel Soldering:

    a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
    b. Promptly remove acid-flux residue from metal after tinning and soldering.
    c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in uncoated aluminum or zinc where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with riveted and soldered joints or joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.
7. Install continuous gutter screens on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.

C. Built-in Gutters:

1. Join sections with riveted and soldered joints or joints sealed with sealant.
2. Provide for thermal expansion.
3. Slope to downspouts.
4. Provide end closures and seal watertight with sealant.
5. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing.

    a. Lap sides minimum of 2 inches (50 mm) over underlying course.
    b. Lap ends minimum of 4 inches (100 mm).
    c. Stagger end laps between succeeding courses at least 72 inches (1830 mm).
    d. Fasten with roofing nails.
    e. Install slip sheet over underlayment.

6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.

D. Downspouts:

1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

E. Splash Pans:

1. Install where downspouts discharge on low-slope roofs.
2. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

F. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

G. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below scupper or gutter discharge.

H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

    a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) or 16-inch (400-mm) centers.
    b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

C. Reglets: Installation of reglets is specified in Section 033000 "Cast-in-Place Concrete" or Section 042000 "Unit Masonry".

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Preinstallation Conference: Conduct conference at Project site.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

D. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Sections as directed.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 or 10 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Listing: Manufacture and install copings or roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60, Class 1-75, Class 1-90, Class 1-105 or Class 1-120. Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install copings or roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness, 0.034-inch (0.86-mm) thickness or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat or embossed finish.
    b. Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.
    c. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.040 inch (1.02 mm) thick, 0.050 inch (1.27 mm) thick, 0.063 inch (1.60 mm) thick or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat or embossed finish.
    b. Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.
    c. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

3. Formed Copper Sheet Coping Caps: Copper sheet, 20 oz./sq. ft. (0.68 mm thick) or weight (thickness) as required to meet performance requirements.

    a. Copper Finish: Non-patinated, mill, Pre-patinated dark brown or Pre-patinated verdigris.

4. Corners: Factory mitered and soldered, continuously welded or mechanically clinched and sealed watertight.
5. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

    a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
    b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet or stainless steel.

2.3 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of snap-on or compression-clamped metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness, 0.034-inch (0.86-mm) thickness or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat or embossed finish.
    b. Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.
    c. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick, 0.050 inch (1.27 mm) thick, 0.063 inch (1.60 mm) thick or thickness as required to meet performance requirements.

    a. Surface: Smooth, flat or embossed finish.
    b. Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.
    c. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and soldered, continuously welded or mechanically clinched and sealed watertight.
4. Splice Plates: Concealed or Exposed, of same material, finish, and shape as fascia cover.
5. Fascia Accessories: Fascia extenders with continuous hold-down cleats, Wall cap, Soffit trim, Overflow scuppers, Overflow scuppers with perforated screens, Spillout scuppers, Downspout scuppers with integral conductor head and downspout adapters or Downspout scuppers with integral conductor head and downspout adapters and perforated screens.

B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.

1. Metallic-Coated Steel Sheet Fascia Covers: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness, 0.034-inch (0.86-mm) thickness or thickness as required to meet performance requirements.

a. Surface: Smooth, flat or embossed finish.
b. Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.
c. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, 0.040 inch (1.02 mm) thick, 0.050 inch (1.27 mm) thick, 0.063 inch (1.60 mm) thick or thickness as required to meet performance requirements.

a. Surface: Smooth, flat or embossed finish.
b. Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.
c. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and soldered, continuously welded or mechanically clinched and sealed watertight.
4. Splice Plates: Concealed or exposed of same material, finish, and shape as fascia cover.
5. Receiver: Galvanized-steel sheet, nominal 0.040-inch (1.02-mm) thickness, Aluminum sheet, 0.050 inch (1.27 mm) thick, extruded aluminum, 0.080 inch (2.03 mm) thick or Manufacturer's standard material and thickness.
6. Fascia Accessories: Fascia extenders with continuous hold-down cleats, Wall cap, Soffit trim, Overflow scuppers, Overflow scuppers with perforated screens, Spillout scuppers, Downspout scuppers with integral conductor head and downspout adapters or Downspout scuppers with integral conductor head and downspout adapters and perforated screens.

C. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg, drain-through fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

1. Metallic-Coated Steel Sheet Gravel Stops: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness, 0.034-inch (0.86-mm) thickness or thickness as required to meet performance requirements.

a. Surface: Smooth, flat or embossed finish.
b. Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.
c. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2. Formed Aluminum Sheet Gravel Stops: Aluminum sheet, 0.040 inch (1.02 mm) thick, 0.050 inch (1.27 mm) thick, 0.063 inch (1.60 mm) thick or thickness as required to meet performance requirements.

a. Surface: Smooth, flat or embossed finish.
b. Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.
c. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

3. Formed Copper Sheet Gravel Stops: Copper sheet, 20 oz./sq. ft. (0.68 mm thick) or weight (thickness) as required to meet performance requirements.

a. Copper Finish: Non-patinated, mill, Pre-patinated dark brown or Pre-patinated verdigris.

4. Corners: Factory mitered and soldered, continuously welded or mechanically clinched and sealed watertight.
5. Accessories: Fascia extenders with continuous hold-down cleats, Wall cap or Soffit trim.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) or 0.034-inch (0.86-mm) thickness.
2. Aluminum Sheet: 0.032 inch (0.81 mm), 0.040 inch (1.02 mm), 0.050 inch (1.27 mm) or 0.063 inch (1.60 mm) thick.
3. Copper Sheet: 16 oz./sq. ft. (0.55 mm thick) or 20 oz./sq. ft. (0.68 mm thick).
4. Gutter Profile: Style A, Style B, Style F, Style G, Style H, Style I, Style K, Style K highback, Half-round single bead, Half-round highback, Quarter round, Ogee or as indicated according to SMACNA's "Architectural Sheet Metal Manual."
5. Corners: Factory mitered and soldered, continuously welded or mechanically clinched and sealed watertight.
6. Gutter Supports: Gutter brackets, Straps, Spikes and ferrules or manufacturer's standard supports as selected by Architect with finish matching the gutters.
7. Gutter Accessories: Continuous screened leaf guard with sheet metal frame, Continuous hinged leaf guard of solid metal designed to shed leaves, Continuous snap-in plastic leaf guard, Bronze wire ball downspout strainer, Wire ball downspout strainer, Flat ends or Bullnose ends for half-round gutter.

B. Downspouts: Plain round, Corrugated round, Plain rectangular, corrugated rectangular or Open-face rectangular complete with machine-crimped, mitered or smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) or 0.034-inch (0.86-mm) thickness.

2. Formed Aluminum: 0.032 inch (0.81 mm), 0.040 inch (1.02 mm), 0.050 inch (1.27 mm) or 0.063 inch (1.60 mm) thick.
3. Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch (100-mm) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scuppers.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71 mm) thickness.
2. Formed Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.
4. Copper: 16 oz./sq. ft. (0.55 mm thick).

D. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, exterior flange trim and built-in overflow.

1. Zinc-Coated Steel: Nominal 0.028-inch (0.71 mm) thickness.
2. Formed Aluminum: 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.016 inch (0.40 mm) thick.
4. Copper: 16 oz./sq. ft. (0.55 mm thick).

E. Zinc-Coated Steel Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

F. Aluminum Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Copper Finish: Non-patinated, mill, Pre-patinated dark brown or Pre-patinated verdigris.

2.5 REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) or 0.028-inch (0.71-mm) thickness.
2. Formed Aluminum: 0.024 inch (0.61 mm) or 0.050 inch (1.27 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) or 0.025 inch (0.64 mm) thick.
4. Copper: 16 oz./sq. ft. (0.55 mm thick).

5. Corners: Factory mitered and soldered or continuously welded or mechanically clinched and sealed watertight.
6. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
7. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
8. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
9. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
10. Multi-use Type, Embedded: For multiuse embedment in cast-in-place concrete or masonry mortar joints.

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch (0.56-mm) or 0.028-inch (0.71-mm) thickness.
2. Formed Aluminum: 0.024 inch (0.61 mm) or 0.032 inch (0.81 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) or 0.025 inch (0.64 mm) thick.
4. Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

D. Zinc-Coated Steel Finish: Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer or Three-coat metallic fluoropolymer.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. Aluminum Finish: Mill, Two-coat fluoropolymer, Three-coat fluoropolymer, Two-coat mica fluoropolymer, Three-coat metallic fluoropolymer, Clear anodic or Color anodic.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

F. Stainless-Steel Finish: No. 2B (bright, cold rolled, unpolished), No. 3 (coarse, polished directional satin) or No. 4 (bright, polished directional satin).

G. Copper Finish: Non-patinated, mill or Pre-patinated verdigris.

2.6 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

D. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.7 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C).

B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.8 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

F. Solder for Copper: ASTM B32, lead-free solder or Grade Sn50, 50 percent tin and 50 percent lead.

2.9 FINISHES

A. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
    b. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
    c. Two-Coat Mica Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat.
    d. Three-Coat Metallic Fluoropolymer: AAMA 621. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

B. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
    b. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
    c. Two-Coat Mica Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat.

d. Three-Coat Metallic Fluoropolymer: AAMA 2605. Fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.
3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Copper Sheet Finishes:

1. Non-Patinated Finish: Mill finish.
2. Pre-Patinated Finish: Chemically treated according to ASTM B882.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings, roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws, substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at 30-inch (762-mm) centers, 40-inch (1016-mm) centers or manufacturer's required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at 24-inch (610-mm) centers, 16-inch (406-mm) centers or manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at 24-inch (610-mm) centers, 16-inch (406-mm) centers or manufacturer's required spacing that meets performance requirements.

3.4 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches (305 mm), 24 inches (610 mm) or 30 inches (762 mm) apart. Attach ends with rivets and seal with sealant or solder to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch (25 mm) below scupper or gutter discharge.

3.6 REGLET AND COUNTERFLASHING INSTALLATION

A. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry" for installation of reglets.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flanged bellows-type roof expansion joints.
2. Aluminum roof expansion joints.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For roof expansion joints.

D. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer of roofing membrane.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Two** years from date of Substantial Completion or as directed.

B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Rating: Comply with ASTM E1966 or UL 2079; testing by a qualified testing agency to resist the spread of fire and to accommodate building thermal and seismic movements without impairing its ability to resist the passage of fire and hot gases. Identify products with appropriate markings of applicable testing agency.

1. Rating: Not less than 1-hour, 2-hour or fire-resistance rating of the roof assembly.
2. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS (AS DIRECTED)

A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to 3- to 4-inch (76- to 100-mm) wide metal flange.

1. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
2. Bellows: EPDM, Neoprene or PVC flexible membrane, nominal 60 mils (1.5 mm) thick.
3. Flanges: Galvanized steel, 0.022 inch (0.56 mm) thick, Copper, 16 oz./sq. ft. (0.55 mm) thick, Stainless steel, 0.019 inch (0.48 mm) thick or Aluminum, 0.032 inch (0.81 mm) thick.
4. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
5. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.

6. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.

    a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture to drain, to exterior-wall expansion joint cover or as indicated on Drawings.
    b. Thermal Insulation: Fill space above secondary seal with mineral-fiber blanket or manufacturer's standard, factory-installed mineral-fiber insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.

7. Fire Barrier: Manufacturer's standard fire barrier for fire-resistance-rated expansion joint system.

B. Materials:

1. Galvanized-Steel Sheet: ASTM A653/A653M, hot-dip zinc-coating designation G90 (Z275).
2. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.
3. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
4. Aluminum Sheet: ASTM B209 (ASTM B209M), mill finish, with temper to suit forming operations and performance required.

    a. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious or preservative-treated wood materials.

5. EPDM Membrane: ASTM D4637/D4637M, type standard with manufacturer for application.
6. Neoprene Membrane: Neoprene sheet recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil; and as standard with roof-expansion-joint manufacturer for application.
7. PVC Membrane: ASTM D4434/D4434M, type standard with manufacturer for application.

2.3 ALUMINUM ROOF EXPANSION JOINTS

A. Aluminum Roof Expansion Joint: Factory-fabricated, continuous, waterproof joint cover; consisting of a formed or extruded metal cover secured to extruded aluminum frames, with water-resistant gasketing between cover and frames, and with provision for securing assembly to substrate and sealing assembly to roofing membrane or flashing.

1. Frame Members: Extruded aluminum configured for curbs, for sloped cants or with integral aluminum curb as indicated; with exposed finish matching cover or as selected by Architect from manufacturer's full range.

2. Cover: Formed aluminum, Extruded aluminum, Formed or extruded aluminum or Stainless steel; thickness as recommended by manufacturer.
3. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
4. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
5. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the cover.

    a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture to drain, to exterior-wall expansion joint cover or as indicated on Drawings.
    b. Thermal Insulation: Fill space above secondary seal with mineral-fiber blanket insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.

6. Fire Barrier: Manufacturer's standard fire barrier for fire-resistance-rated expansion joint system.

B. Materials:

1. Aluminum: ASTM B209 (ASTM B209M) for sheet and plate, ASTM B221 (ASTM B221M) for extrusions; alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

    a. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious or preservative-treated wood materials.
    b. Mill Finish: As manufactured.
    c. Class II, Clear Anodic Finish: Architectural Class II, clear coating 0.010 mm or thicker, complying with AAMA 611.
    d. Class I, Clear Anodic Finish: Architectural Class I, clear coating 0.018 mm or thicker, complying with AAMA 611.
    e. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

        1) Two-Coat Fluoropolymer: System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

    f. Aluminum Finish Color: Light bronze, Medium bronze, Dark bronze, as indicated by manufacturer's designations or as selected by Architect from manufacturer's full range.

2. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304; finish 2B.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: As recommended by roof-expansion-joint manufacturer.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.

C. Mineral-Fiber Blanket: ASTM C665.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
3. Provide for linear thermal expansion of roof expansion joint materials.

B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.

C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with other exterior expansion-control joint assemblies specified in Section 079513.16 "Exterior Expansion Joint Cover Assemblies" to result in watertight performance. Install factory-fabricated units at transitions between roof expansion joints and exterior expansion-control joint systems.

D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.

E. Fire Barrier: Install fire barrier as required by manufacturer to provide continuous, uninterrupted fire resistance throughout length of roof expansion joint, including transitions and end joints.

F. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

END OF SECTION 077129

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof hatches.
4. Smoke vents.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

B. Shop Drawings: For roof accessories.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 or 10 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.052 inch (1.32 mm), 0.064 inch (1.63 mm) or 0.079 inch (2.01 mm) thick.

1. Finish: Mill phosphatized, Factory prime coating, Two-coat fluoropolymer, Baked enamel or powder coat.
2. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. Material: Aluminum sheet, 0.090 inch (2.28 mm) or 0.125 inch (3.17 mm) thick.

1. Finish: Mill, Factory prime coating, Clear anodic, Color anodic, Two-coat fluoropolymer, Baked enamel or powder coat.
2. Color: As indicated by manufacturer's designations, match Architect's sample, as selected by Architect from manufacturer's full range, Light bronze, Medium bronze or Dark bronze.

E. Material: Stainless steel sheet, 0.078 inch (1.98 mm) thick.

1. Finish: Manufacturer's standard or ASTM A480/A480M, No. 2D, directional polish finish.

F. Construction:

1. Curb Profile: Manufacturer's standard or Profile as indicated on Drawings compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.

5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch (38-mm thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer along top flange of curb or under top flange on side of curb, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch (19-mm) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Security Grille: Provide for all units or provide where indicated.
13. Damper Tray: Provide damper tray or shelf with opening 3 inches (76 mm) less than interior curb dimensions indicated or of size indicated.

2.2 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter or Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.052 inch (1.32 mm), 0.064 inch (1.63 mm) or 0.079 inch (2.01 mm) thick.

1. Finish: Mill phosphatized, Factory prime coating, Two-coat fluoropolymer, Baked enamel or powder coat.
2. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. Material: Aluminum sheet, 0.090 inch (2.28 mm) or 0.125 inch (3.17 mm) thick.

1. Finish: Mill, Factory prime coating, Clear anodic, Color anodic, Two-coat fluoropolymer, Baked enamel or powder coat.
2. Color: As indicated by manufacturer's designations, match Architect's sample, as selected by Architect from manufacturer's full range, Light bronze, Medium bronze or Dark bronze.

E. Material: Stainless steel sheet, 0.078 inch (1.98 mm) thick.

1. Finish: Manufacturer's standard or ASTM A480/A480M, No. 2D, directional polish finish.

F. Construction:

1. Curb Profile: Manufacturer's standard or Profile as indicated on Drawings compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch (38-mm) thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches (90 mm) or 5-1/2 inches (140 mm) wide on top flange of equipment supports or under top flange on side of curb, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch (19-mm) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.
11. Security Grille: Provide for all units or provide where indicated on Drawings.

2.3 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated single or double walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

B. Type and Size: Single-leaf lid, 30 by 36 inches (750 by 900 mm), 36 by 36 inches (900 by 900 mm), 30 by 54 inches (750 by 1370 mm) or 30 by 96 inches (750 by 2440 mm).

C. Type and Size: Double-leaf lid, 72 by 96 inches (1830 by 2440 mm).

D. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

1. Dome Glazing: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

E. Hatch Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated or 0.079 inch (2.01 mm).
2. Finish: Mill phosphatized, Factory prime coating, Two-coat fluoropolymer or Baked enamel or powder coat.
3. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

F. Hatch Material: Aluminum sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated or 0.079 inch (2.01 mm).
2. Finish: Mill, Factory prime coating, Clear anodic, Color anodic, Two-coat fluoropolymer or Baked enamel or powder coat.
3. Color: As indicated by manufacturer's designations, match Architect's sample, as selected by Architect from manufacturer's full range, Light bronze, Medium bronze or Dark bronze.

G. Hatch Material: Stainless steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated or 0.078 inch (1.98 mm).
2. Finish: Manufacturer's standard or ASTM A480/A480M, No. 2D, directional polish finish.

H. Construction:

1. Insulation: 1-inch (25-mm) thick, cellulosic-fiber board, 1-inch (25-mm) thick, glass-fiber board, 2-inch (50-mm) thick, polyisocyanurate board.

    a. R-Value: 2.78, 4.3 or 12.0 according to ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
5. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
6. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

7. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
8. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant or tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

I. Hatch-Lid Glazing: Single, Double, acrylic or polycarbonate glazing of thickness capable of resisting indicated loads.

1. Single-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.
2. Outer Double-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.
3. Inner Double-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.

J. Hardware: Spring operators, hold-open arm, galvanized or stainless steel spring latch with turn handles, galvanized or stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).
2. Provide remote-control operation.

K. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches (1060 mm) above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: Manufacturer's standard.

a. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

L. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches (1060 mm) above finished roof deck.
3. Material: Steel tube, Stainless steel or Aluminum.
4. Post: 1-5/8-inch (41-mm) diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

a. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.4 HEAT AND SMOKE VENTS

A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with single or double walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 deg F (74 deg C), fire-suppression system or smoke-detection system.

1. Type and Size: Single-leaf lid, size as indicated on Drawings, 30 by 36 inches (750 by 900 mm), 30 by 54 inches (750 by 1370 mm) or 30 by 96 inches (750 by 2440 mm).
2. Type and Size: Double-leaf lid, 72 by 96 inches (1830 by 2440 mm).
3. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 30-lbf/sq. ft. (1.4-kPa) internal uplift load.

a. When release is actuated, lid shall open against 10-lbf/sq. ft. (0.5-kPa) snow or wind load and lock in position.
b. Hatch-Lid Glazing: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

4. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793 and are FM Approved.
5. Curb, Framing, and Lid Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet.

a. Thickness: Manufacturer's standard thickness for hatch size indicate or 0.079 inch (2.01 mm).
b. Finish: Mill phosphatized, Factory prime coating, Two-coat fluoropolymer or Baked enamel or powder coat.

c. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

6. Curb, Framing, and Lid Material: Aluminum sheet.

a. Thickness: Manufacturer's standard thickness for hatch size indicated or 0.079 inch (2.01 mm).
b. Finish: Mill, Factory prime coating, Clear anodic, Color anodic, Two-coat fluoropolymer or Baked enamel or powder coat.
c. Color: As indicated by manufacturer's designations, match Architect's sample, as selected by Architect from manufacturer's full range, Light bronze, Medium bronze or Dark bronze.

7. Construction:

a. Insulation: 1-inch (25-mm) thick, cellulosic-fiber board or 1-inch (25-mm) thick, glass-fiber board or 2-inch (50-mm) thick, polyisocyanurate board.

1) R-Value: 2.78, 4.3 or 12.0 according to ASTM C1363.

b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
c. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
d. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
e. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
f. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
g. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant or tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
h. Security Grille: Provide for all units or provide where indicated on Drawings.

8. Hatch-Lid Glazing: Single, Double, acrylic or polycarbonate glazing of thickness capable of resisting indicated loads; colorless, transparent or white, translucent.
9. Hardware: Manufacturer's standard corrosion resistant or stainless steel; with hinges, hold-open devices, and independent manual-release devices for inside and outside operation of lids.

B. Dropout-Type Heat and Smoke Vents: Manufacturer's standard, gravity operated and automatic; with single or double walled insulated curbs and frame, welded or mechanically fastened and sealed corner joints, integral condensation gutter, cap flashing, and heat-sensitive dome glazing that will deform and drop out of vent opening according to heat and smoke vent standard indicated.

1. Size: As indicated on Drawings, 48 by 48 inches (1219 by 1219 mm), 48 by 60 inches (1219 by 1524 mm), 48 by 72 inches (1219 by 1829 mm), 48 by 90 inches (1219 by 2286 mm) or 48 by 96 inches (1219 by 2438 mm).
2. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 30-lbf/sq. ft. (1.4-kPa) internal uplift load.

    a. Dome Glazing: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

3. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793 and are FM Approved.
4. Curb and Framing Material: Aluminum sheet.

    a. Thickness: Manufacturer's standard thickness for vent size indicated or 0.079 inch (2.01 mm).
    b. Finish: Mill, Factory prime coating, Clear anodic, Color anodic, Two-coat fluoropolymer or Baked enamel or powder coat.
    c. Color: As indicated by manufacturer's designations, match Architect's sample, as selected by Architect from manufacturer's full range, Light bronze, Medium bronze or Dark bronze.

5. Construction:

    a. Insulation: Manufacturer's standard.
    b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
    c. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
    d. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
    e. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant or tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip unit with water diverter or cricket on side that obstructs water flow.

6. Dome Glazing: Single, Double, acrylic or polycarbonate glazing of thickness capable of resisting indicated loads.

    a. Single-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.
    b. Outer Double-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.
    c. Inner Double-Dome Color: Colorless, transparent, White, translucent, Gray tinted, transparent or Bronze tinted, transparent.

7. Fall Protection Safety Structure: Manufacturer's standard meeting impact load requirements of 29 CFR 1910.23 and authorities having jurisdiction, equipped with hail

protection galvanized steel wire mesh screen and manually openable from exterior without special tools.

8. Hardware: Manufacturer's standard, corrosion resistant; with hinges, hold-open devices, and independent manual-release devices for inside and outside operation of lids.

2.5 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation and mill phosphatized for field painting where indicated.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

4. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 (AZM150) coated.

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

3. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Sheet: ASTM B209 (ASTM B209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
3. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.
4. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
5. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

6. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
7. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

D. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

G. Steel Tube: ASTM A500/A500M, round tube.

H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

I. Steel Pipe: ASTM A53/A53M, galvanized.

2.6 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Acrylic Glazing: ASTM D4802, thermoformable, monolithic sheet, manufacturer's standard, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

C. Polycarbonate Glazing: Thermoformable, monolithic polycarbonate sheets manufactured by extrusion process, burglar-resistance rated according to UL 972 with an average impact strength of 12 to 16 ft-lbf/in. (640 to 854 J/m) of width when tested according to ASTM D256, Method A (Izod).

D. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

E. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.

F. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

G. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

H. Security Grilles: 3/4-inch (19-mm) diameter, ASTM A1011/A1011M steel bars spaced 6 inches (150 mm) o.c. in one direction and 12 inches (300 mm) o.c. in the other, shop-primed for field finish. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

I. Underlayment:

1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil (0.15-mm) thick polyethylene sheet complying with ASTM D4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

J. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

K. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

L. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

M. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Security Grilles: Weld bar intersections and using tamper-resistant bolts, attach the ends of bars to structural frame or primary curb walls.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-type, flat-mounted snow guards.
2. Pad-type, seam-mounted snow guards.
3. Rail-type, flat-mounted snow guards.
4. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Pad-Type Snow Guards: Full-size unit.

a. For units with factory-applied finishes, submit manufacturer's standard color selections or specified color.

2. Rail-Type Snow Guards: Bracket and 12-inch (300-mm) long rail.

a. For units with factory-applied finishes, submit manufacturer's standard color selections or specified color.

D. Delegated-Design Submittal: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the jurisdiction or state in which the Project is located.

B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating point of failure of attachment to roof system identical as that used on this Project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to building, based on the following:

1. Roof snow load.
2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: **2** or **3**, as directed.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Structural Performance: Snow guards shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: As indicated on Drawings.

2.2 PAD-TYPE SNOW GUARDS

A. Flat-Mounted Metal Pad-Type Snow Guards:

1. Material: ASTM B209 (ASTM B209M), 0.032-inch- (0.81-mm-), 0.040-inch- (1.02-mm-) or 0.050-inch- (1.27-mm-) thick aluminum sheet.

a. Finish: Mill, Black epoxy coating, Powder coat finish complying with AAMA 2603, with a minimum dry film thickness of 1.5 mils (0.04 mm) or High-performance organic two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1) Color: As selected by Architect from manufacturer's full range or match sheet metal roofing.

2. Material: ASTM B26/B26M cast aluminum.
3. Material: ASTM B584 cast bronze
4. Material: ASTM B370, 16 oz./sq. ft. (0.55-mm thick) copper sheet.
5. Material: ASTM A653/A653M, 0.022-inch (0.56-mm) thick metallic-coated steel sheet with G90 (Z275) costing.

a. Finish: Powder coat finish complying with AAMA 2603, with a minimum dry film thickness of 1.5 mils (0.04 mm) or High-performance organic two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1) Color: As selected by Architect from manufacturer's full range or match sheet metal roofing.

6. Material: ASTM A792/A792M, Class AZ50 (Class AZM150) 0.022-inch- (0.56-mm-) thick aluminum-zinc alloy-coated steel sheet, Grade 40 (Grade 275).

a. Finish: High-performance organic two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1) Color: As selected by Architect from manufacturer's full range or match sheet metal roofing.

7. Material: ASTM A240/A240M, Type 304 or Type 316 0.016-inch (0.40-mm) thick stainless steel sheet.

a. Finish: ASTM A480/A480M, No. 2D, No. 2B, No. 3 or No. 4.

8. Attachment: Manufacturer's tested system, capable of resisting design loads.

B. Flat-Mounted Plastic Pad-Type Snow Guards:

1. Material: ASTM D6098 polycarbonate.

a. Color: As selected by Architect from manufacturer's full range.

2. Attachment: Manufacturer's tested system, capable of resisting design loads.

C. Seam-Mounted Metal Pad-Type Snow Guards:

1. Material: ASTM B26/B26M cast aluminum; mill or factory black epoxy finish.
2. Material: ASTM B584 cast bronze; polished finish.
3. Material: Cast brass; polished finish.
4. Attachment: Manufacturer's tested system, capable of resisting design loads.

2.3 RAIL-TYPE SNOW GUARDS

A. Flat-Mounted, Rail-Type Snow Guards:

1. Description: Units fabricated from metal baseplate anchored to adjustable or fixed bracket and equipped with one, two or three bars, rails, or pipes.
2. Brackets and Baseplate: Aluminum; mill finished, Aluminum; clear anodized, Bronze or brass or Type 304 stainless steel; mill finish.
3. Bars: Aluminum; mill finished, Aluminum; clear anodized, Bronze or brass or Type 304 stainless steel; mill finished.
    a. Profile: Round, Square or with integral track to accept color-matching inserts of material and finish used for metal roof.
4. Seam clamps: ASTM B221 (ASTM B221M) aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

B. Seam-Mounted, Rail-Type Snow Guards:

1. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with one rail, two rails, three rails or one rail with integral track to accept color-matching inserts of material and finish used for metal roof.
2. Material and Finish: Aluminum; mill or clear anodized.
3. Material and Finish: Type 304 stainless steel; mill, 180-grit polished finish, uniform, directionally textured finish or 320-grit polished finish, oil-ground, uniform, fine, directionally textured finish.
4. Material and Finish: Brass; polished.
5. Seam clamps: ASTM B221 (ASTM B221M) aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Drawings or Shop Drawings.
2. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:

1. Flat-Mounted, Pad-Type Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles or Retrofit mechanical anchor and counterflashing sleeve system.
2. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

C. Attachment for Wood Shingle and Shake Roofing:

1. Flat-Mounted, Pad-Type Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles, retrofit mechanical anchor and counterflashing sleeve system or hook and mechanically anchored through each factory-prepared hole, concealed by shingles and shakes.
2. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

D. Attachment for Slate Shingle Roofing:

1. Flat-Mounted, Pad-Type Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles, retrofit strap-and-hook system, retrofit mechanical anchor and counterflashing sleeve system or hook and mechanically anchored through each factory-prepared hole, concealed by shingles.
2. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

E. Attachment for Metal Shingle Roofing:

1. Flat-Mounted, Pad-Type Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles or Mechanical anchor and counterflashing sleeve system.
2. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

F. Attachment for Tile Roofing:

1. Flat-Mounted, Pad-Type Snow Guards: Hooked to tile and roof batten with head of snow guard positioned overhead lap of tile, hook and mechanically anchored through each factory-prepared hole, concealed by roof tiles.
2. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

G. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
2. Flat-Mounted, Pad-Type Snow Guards:

    a. Mechanically attach or adhere to metal roofing according to manufacturer's instructions.
    b. Solder to copper roofing according to manufacturer's instructions.

3. Seam-Mounted, Pad-Type Snow Guards:

    a. Install snow guards in straight rows.
    b. Secure in place using stainless steel set screws, incorporating round nonpenetrating point.
    c. Torque set screw according to manufacturer's instructions.

4. Seam-Mounted, Rail-Type Snow Guards:

    a. Install brackets to vertical ribs in straight rows.
    b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
    c. Torque set screw according to manufacturer's instructions.
    d. Install cross members to brackets.

H. Attachment for Exposed Fastened Metal Roofing:

1. Do not use fasteners that will void metal roofing finish warranty.
2. Flat-Mounted, Pad-Type Snow Guards:

    a. Adhere to metal roofing according to manufacturer's instructions.
    b. Mechanically fasten to metal roofing, using fasteners identical to those used to secure metal roofing to substrate.
    c. Solder to copper roofing according to manufacturer's instructions.

3. Flat-Mounted, Rail-Type Snow Guards:

    a. Install brackets in straight rows.
    b. Mechanically fasten to metal roofing, using sealant and mechanical fasteners identical to those used to secure metal roofing to substrate.
    c. Install cross members to brackets.

I. Attachment for Roofing:

1. As directed.

END OF SECTION 077253

SECTION 077273 - VEGETATED ROOF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Continuous vegetated roof assemblies.
2. Tray-type vegetated roof assemblies.
3. Walkway pavers.

1.2 DEFINITIONS

A. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each vegetated roof assembly.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each vegetated roof assembly.

1. Include plans, sections, slopes, and drain locations.
2. Detail field assembly of components, depth of growing media, and attachments to other work.
3. Indicate walkway pavers, locations of irrigation, coordination with lighting and accessories.

D. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified vegetated roof assembly Installer, approved, authorized, or licensed by roofing-membrane manufacturer, whose work has resulted in successful establishment of vegetated roofs.

1.8 WARRANTY

A. Special Warranty for Vegetated Roof Assembly: Installer agrees to repair or replace components of vegetated roof assembly that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion or Planting Completion, as directed.

PART 2 - PRODUCTS

2.1 VEGETATED ROOF ASSEMBLIES

A. Continuous Vegetated Roof Assembly: Continuous-coverage assembly consisting of manufacturer's standard vegetated roof assembly components for installation over roofing system.

1. Assembly Depth, Nominal: 3 inches (75 mm), 4 inches (100 mm), 6 inches (150 mm)] [8 inches (200 mm), manufacturer's standard for required plantings or as shown on Drawings, including growing medium.
2. Assembly Weight: Maximum 15 lb/sq. ft. (73 kg/sq. m) or 28 lb/sq. ft. (137 kg/sq. m), including growing medium and plants except for large perennials and trees and saturated with captured water, but not including weight of roofing system.
3. Plantings: Preplanted vegetative mat as selected by Architect from manufacturer's standard mixes, Sedum as selected by Architect from manufacturer's standard varieties or as shown on Drawings.

B. Tray-Type Vegetated Roof Assembly: Modular assembly consisting of manufacturer's standard, preplanted trays for field assembly adjacent to and interlocking with each other over roofing system.

1. Tray Depth, Nominal: 4 inches (100 mm), 6 inches (150 mm), 8 inches (200 mm) or Manufacturer's standard for required plantings.
2. Tray Size: 24 by 24 inches (610 by 610 mm), 46 by 46 inches (1168 by 1168 mm), manufacturer's standard or as shown on Drawings.
3. Assembly Weight: Maximum 15 lb/sq. ft. (73 kg/sq. m) or 28 lb/sq. ft. (137 kg/sq. m), including growing medium and plants except for large perennials and trees saturated with captured water, but not including weight of roofing system.
4. Plantings: Preplanted vegetative mat as selected by Architect from manufacturer's standard mixes, Sedum as selected by Architect from manufacturer's standard varieties or as shown on Drawings.

2.2 VEGETATED ROOF ASSEMBLY COMPONENTS: As directed.

2.3 MANUFACTURED GROWING MEDIA

A. Growing Medium: Vegetated roof assembly manufacturer's lightweight, manufactured soil mixture designed for plants indicated on Drawings, Planting Area 1 or Planting Area 2 and Tree Type 1.

2.4 WALKWAY PAVERS

A. Heavyweight Concrete Walkway Pavers: Heavyweight, hydraulically pressed, concrete units, manufactured for use as roof- or plaza-deck pavers; with absorption not greater than 5 percent according to ASTM C140; with no breakage and maximum 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.

1. Thickness: 1-5/8 inches (41 mm), 1-3/4 inches (45 mm), 2 inches (51 mm) or 2-3/8 inches (60 mm).
2. Face Size: 8-7/8 inches (225 mm) square, 9 inches (229 mm) square, 9 by 18 inches (229 by 457 mm), 12 inches (305 mm) square, 12 by 24 inches (305 by 610 mm), 18 inches (457 mm) square, 24 inches (610 mm) square or as indicated.
3. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

B. Setting Bed: Aggregate setting-bed material furnished standard by vegetated roof assembly manufacturer or as specified in Section 321400 "Unit Paving".

C. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including fixed-height, adjustable or stackable pedestals, shims, and spacer tabs for joint spacing of 1/8 inch (3 mm), 3/16 inch (5 mm) or 1/8 to 3/16 inch (3 to 5 mm).

2.5 ACCESSORIES

A. Protection Board: As recommended by roofing-membrane manufacturer.

B. Access Boxes: Manufacturer's standard stainless-steel, plastic, fiber-reinforced cement or aluminum boxes with removable, rigid covers for accessing drains, valves, and switches beneath the finish elevation of growing medium; secure each cover with four noncorrosive screws.

C. Soil Retainer: Vegetated roof assembly manufacturer's polyethylene or vinyl or extruded-aluminum or formed stainless-steel edging with drainage openings.

1. Configuration: L-shaped, T-shaped, Flat-top curb, manufacturer's standard or as shown on Drawings.
2. Color: Black or Mill-finish metal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine each area to receive vegetated roof assembly.

1. Verify that roof insulation over roofing membrane is in place, secure, and flush along all seams.
2. Verify that perimeter and other flashings are in place and secure along entire lengths where they will be covered by vegetated roof assembly.

3.2 INSTALLATION, GENERAL

A. Protection Course: Cover roofing system with protection board with butted and fully taped joints before roofing system is subject to vegetated roof assembly installation work.

B. Install vegetated roof assembly according to manufacturer's written instructions.

C. Small Plant Stabilization: Install erosion-control fabric over planting area to secure small plants according to manufacturer's written instructions.

D. Access Boxes: Install access box at each drain, valve, and switch and at locations shown on Drawings. Install top of boxes level with, beneath or 1 inch (25 mm) above the finish elevation of growing medium.

3.3 PLANTING

A. Perform planting according to vegetated roof assembly manufacturer's written instructions.

B. Preplanted Vegetative Mat: Install in full contact with growing medium and secure in position.

C. Seeding Grasses: Sow seed at a total rate of 2 lb/1000 sq. ft. (0.9 kg/92.9 sq. m), 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m) or 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m).

D. Meadow Grasses and Wildflowers: Sow seed at a total rate of 4 oz./1000 sq. ft. (113 g/92.9 sq. m), 5 oz./1000 sq. ft. (142 g/92.9 sq. m) or 6 oz./1000 sq. ft. (170 g/92.9 sq. m).

E. Sprigging Grasses: Plant individual sprigs with roots and portions of stem in moistened growing medium, 6 inches (150 mm) or 12 inches (300 mm) apart in rows 10 inches (250 mm) or 12 inches (300 mm) apart, and fill furrows without covering growing tips. Lightly roll and firm growing medium around sprigs after planting.

F. Plugging: Plant plugs in holes or furrows, spaced 12 inches (300 mm) apart in both directions or triangular pattern.

G. Individual Plant Planting: Set out and space plants other than grasses and wildflowers 9 inches (225 mm) apart, 12 inches (300 mm) apart, 18 inches (450 mm) apart, 24 inches (600 mm) apart or as indicated on Drawings in even rows with triangular spacing.

1. Dig holes large enough to allow spreading of roots.
2. Water thoroughly after planting, taking care not to cover plant crowns with wet growing medium.
3. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.4 WALKWAY-PAVER INSTALLATION

A. Setting Bed: Install setting bed according to paver manufacturer's written instructions or requirements in Section 321400 "Unit Paving".

B. Install paver supports according to pedestal manufacturer's written instructions. Adjust for final level and slope with shims.

C. Loosely set walkway pavers, maintaining a uniform joint width. Tightly seat pavers against spacers to eliminate lateral movement or drift of paving assembly. Align joint patterns parallel in each direction.

1. Lay out pavers to avoid less-than-half-width pavers at perimeter or other terminations.

D. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

3.5 SOIL-RETAINER INSTALLATION

A. Install soil retainer where indicated according to manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage roofing-membrane manufacturer's authorized service representative to provide full-time inspection of vegetated roof assembly installation.

B. Prepare inspection reports.

3.7 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of vegetated roof assembly Installer approved by roofing-membrane manufacturer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the specified maintenance period.

1. Assembly and Plant Maintenance: During maintenance period, maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

a. Replace growing medium that becomes displaced or eroded because of settling or other processes.
b. Use only products and methods acceptable to roofing-membrane manufacturer.

2. Maintenance Period: 12 months from date of Substantial Completion or Planting Completion, as directed.

END OF SECTION 077273

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sprayed fire-resistive materials.

B. Related Requirements:

1. Section 078123 "Intumescent Fireproofing" for mastic and intumescent fire-resistive coatings.
2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding but not fire resistive.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Evaluation reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.

1. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
2. Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa), 430-lbf/sq. ft. (20.59-kPa) or 1000-lbf/sq. ft. (47.88-kPa) cohesive and adhesive strength based on field testing according to ASTM E736.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch (9 mm).
4. Combustion Characteristics: ASTM E136.
5. Surface-Burning Characteristics: Comply with ASTM E84.
    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 10 or less.
6. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa), 100 lbf/sq. in. (689 kPa) or 300 lbf/sq. in. (2068 kPa) according to ASTM E761.

7. Corrosion Resistance: No evidence of corrosion according to ASTM E937.
8. Deflection: No cracking, spalling, or delamination according to ASTM E759.
9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760.
10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E859.
11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 according to ASTM D3274 when tested according to ASTM D3273.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer for the required fire-resistance design.

C. Bonding Agent: Product approved by fireproofing manufacturer.

D. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

D. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage or Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials" or as indicated on Schedule of Special Inspections.

B. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

C. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Repair fireproofing damaged by other work before concealing it with other construction.

C. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 078123 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings.

B. Related Requirements:

1. Section 078100 "Applied Fireproofing" for sprayed fire-resistive materials (SFRM).
2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding, but not fire resistive.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As submitted.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Evaluation reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. Mastic and Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Application: Designated for "exterior", "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
2. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
3. Surface-Burning Characteristics: Comply with ASTM E84.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or 450 or less.

4. Finish: As selected by Architect from manufacturer's standard finishes, Spray-textured finish or Rolled, spray-textured finish.

    a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer for the required fire-resistance design.

C. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

D. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

E. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage or Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.14, "Mastic and Intumescent Fire-Resistant Coatings" or as indicated on Schedule of Special Inspections.

B. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

C. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Repair fireproofing damaged by other work before concealing it with other construction.

C. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078200 - BOARD FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Calcium silicate board fire protection.
2. Mineral-fiber board fire protection.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Locations and types of surface preparations required before applying board fire protection.
2. Extent of board fire protection for each construction and fire-resistance rating.

    a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" OR UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for board fire protection serving as direct-applied protection tested according to ASTM E119.

2.2 BOARD FIRE PROTECTION

A. Calcium Silicate Board: Rigid board containing no asbestos and consisting primarily of lime, silica, inert fillers, and cellulosic reinforcing fibers; of thickness required to produce fire-resistance rating indicated; with flame-spread and smoke-developed indexes of zero according to ASTM E84; passing ASTM E136 for combustion characteristics.

1. Finish: Sanded finish on both sides or one side.

B. Mineral-Fiber Board: Unfaced, Foil-faced or Fiberglass mat-faced rigid board produced by combining slag-wool-/rock-wool fibers with thermosetting resin binders passing ASTM E136 for combustion characteristics; of thickness required to produce fire-resistance rating indicated.

1. Maximum Density: 8 lb/cu. ft. (128 kg/cu. m), 10 lb/cu. ft. (160 kg/cu. m) or 12 lb/cu. ft. (192 kg/cu. m).
2. Surface-Burning Characteristics: Flame-spread and smoke-developed indexes of 15 or zero and 5 or zero respectively, according to ASTM E84.

2.3 ACCESSORIES

A. Anchorage Accessories: Provide manufacturer's standard board-anchorage components complying with related design of UL or of another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Joint Treatment and Finishing Materials: For calcium silicate board applications exposed to view, provide joint treatment tape and joint compounds recommended in writing by board manufacturer for finishing surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Welded-Stud Systems: Remove rust and scale from steel substrates at welded-steel-stud anchorage locations.

B. Install board fire protection according to manufacturer's written instructions.

C. Install board fire protection to comply with requirements for layer thicknesses and number, construction of joints and corners, and anchorage methods applicable to fire-resistance-rated assemblies indicated.

D. Install enclosing or concealing construction only after board fire protection has been applied and inspected by authorities having jurisdiction

E. Finish calcium silicate board exposed to view or where indicated on Drawings to comply with board manufacturer's written instructions and as follows:

1. At joints in calcium silicate board, embed tape in joint compound and apply first, fill, and finish coats of joint compounds over tape, fastener heads, and accessories.
2. Apply a thin, uniform skim coat of joint compound over entire surface.
3. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges.

3.2 PROTECTION

A. Replace or repair board fire protection that has been cut away to facilitate other construction. Maintain complete coverage of full thickness on members and substrates protected by board fire protection.

1. Provide final protection and maintain conditions in a manner acceptable to Installer, manufacturer, and authorities having jurisdiction to ensure that board fire protection is without damage or deterioration at time of Substantial Completion.

END OF SECTION 078200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior curtain-wall/floor intersections.
3. Joints in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.

1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.

E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

D. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical

fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078443

SECTION 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preformed, foam joint seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each preformed joint seal product.

B. Samples for Verification: For each type and color of preformed joint seal required.

C. Preformed joint seal schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 WARRANTY

A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Design Criteria:

   a. Nominal Joint Width: As directed.
   b. Minimum Joint Width: As directed.
   c. Maximum Joint Width: As directed.
   d. Movement Capability: -25 percent/+25 percent or as directed.

2. Joint Seal Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.

2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces.

3.2 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

END OF SECTION 079100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Mildew-resistant joint sealants.
6. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each kind and color of joint sealant required.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction laboratory test reports.

C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone or masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

C. Silicone, S, NS, 35, NT: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability. nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT.

D. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

E. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

F. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

G. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

H. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

I. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

J. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade P, Class 100/50, Uses T and NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

D. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

E. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

C. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

D. Urethane, S, P, 35, T, NT: Single-component, pourable, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 35, Uses T and NT.

E. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

F. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

G. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.

H. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.

I. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

J. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

K. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.5 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247, Class 1 or Class 2; tested in deionized water unless otherwise indicated

B. Urethane, Immersible, S, NS, 100/50, NT, I: Immersible, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses NT, and I.

C. Urethane, Immersible, S, NS, 35, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Use NT and I.

D. Urethane, Immersible, S, NS, 50, T, NT, I: Immersible, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T, NT, and I.

E. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Uses T, NT, and I.

F. Urethane, Immersible, S, NS, 25, T, NT, I: Immersible, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T, NT, and I.

G. Urethane, Immersible, S, P, 50, T, NT, I: Immersible, single-component, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 50, Uses T, NT, and I.

H. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T, NT, and I.

I. Urethane, Immersible, M, NS, 50, T, NT, I: Immersible, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T, NT, and I.

J. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

K. Urethane, Immersible, M, P, 25, T, NT, I: Immersible, multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T, NT, and I.

2.6 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.7 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units, including steps.
e. Tile control and expansion joints.
f. Joints between different materials listed above.
g. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.

1. Joint Locations:

   a. Joints in pedestrian plazas.
   b. Joints in swimming pool decks.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Construction joints in cast-in-place concrete.
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in dimension stone cladding.
   e. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As indicated by manufacturer's designations or match Architect's sample or as selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

   a. Isolation joints in cast-in-place concrete slabs.
   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in brick flooring.
   d. Control and expansion joints in tile flooring.
   e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of unit masonry, concrete, walls and partitions.
d. Joints on underside of plant-precast structural concrete beams and planks.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Tile control and expansion joints where indicated.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

H. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Sustainable Design Submittals: As directed.

C. Samples: For each kind and color of acoustical joint sealant required.

D. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Colors of Exposed Acoustical Joint Sealants: As indicated by manufacturer's designations, match Architect's samples or as selected by Architect from manufacturer's full range of colors.

B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

C. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

END OF SECTION 079219

SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior expansion joint cover assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams and a tabular schedule of expansion joint cover assemblies.

C. Samples: For each expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria:

1. Type of Movement: Thermal or Wind sway.

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.

2. Type of Movement: Seismic.

a. Joint Movement: As indicated on Drawings.

2.3 FLOOR EXPANSION JOINT COVERS

A. Metal-Plate Floor Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.

1. Application: Floor to floor or floor to wall.
2. Installation: Surface mounted.
3. Load Capacity:

a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
b. Concentrated Load: 300 lb (136 kg).
c. Maximum Deflection: 0.0625 inch (1.6 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Cover-Plate Design: Plain, Serrated or Abrasive covered.
6. Exposed Metal:

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

B. Center-Plate Floor Joint Cover: Assembly consisting of center plate that slides over metal frames fixed to sides of joint gaps.

1. Application: Floor to floor or Floor to wall.
2. Installation: Surface mounted, Recessed or No bump.
3. Load Capacity:

a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
b. Concentrated Load: 300 lb (136 kg).

c. Maximum Deflection: 0.0625 inch (1.6 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Cover-Plate Design: Plain, Serrated or Abrasive covered.
6. Exposed Metal:

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Glide-Plate Floor Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.

1. Application: Floor to floor or Floor to wall.
2. Installation: Recessed.
3. Load Capacity:

a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
b. Concentrated Load: 300 lb (136 kg).
c. Maximum Deflection: 0.0625 inch (1.6 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Exposed Metal:

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

D. Elastomeric-Seal Floor Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Application: Floor to floor or Floor to wall.
2. Installation: Surface mounted or Recessed.
3. Load Capacity:

a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
b. Concentrated Load: 300 lb (136 kg).
c. Maximum Deflection: 0.0625 inch (1.6 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

6. Seal: Preformed elastomeric membrane or extrusion.

    a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

E. Dual-Elastomeric-Seal Floor Joint Cover: Assembly consisting of dual-elastomeric seals and center plate anchored to frames fixed to sides of joint gap.

1. Application: Floor to floor or Floor to wall.
2. Installation: Recessed.
3. Load Capacity:

    a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
    b. Concentrated Load: 300 lb (136 kg).
    c. Maximum Deflection: 0.0625 inch (1.6 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Center-Plate Design: Plain, Serrated or Recessed to accept field-applied finish materials.

    a. Center-Plate Recess Depth: As required to accommodate adjacent flooring, 1/8 inch (3 mm) or 3/8 inch (10 mm).

6. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

7. Seal: Preformed elastomeric membranes or extrusions.

    a. Color: Black, Gray] or as selected by Architect from manufacturer's full range.

2.4 WALL EXPANSION JOINT COVERS

A. Metal-Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.

1. Application: Wall to wall or Wall to corner.
2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

B. Center-Plate Wall Joint Cover: Assembly consisting of center plate that slides over gaskets in metal frames fixed to sides of joint gaps.

1. Application: Wall to wall or Wall to corner.
2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Glide-Plate Wall Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.

1. Application: Wall to wall or Wall to corner.
2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

D. Elastomeric-Seal Wall Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Application: Wall to wall or Wall to corner.
2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

4. Seal: Preformed elastomeric membranes or extrusions.

    a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

E. Dual-Elastomeric-Seal Wall Joint Cover: Assembly consisting of dual-elastomeric seals and center plate anchored to frames fixed to sides of joint gap.

1. Application: Wall to wall or Wall to corner.
2. Fire-Resistance Rating: Not less than, that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Center-Plate Design: Plain, recessed to accept gypsum board or recessed to accept wall tile.
4. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

5. Seal: Preformed elastomeric membranes or extrusions.

    a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

2.5 CEILING EXPANSION JOINT COVERS

A. Glide-Plate Ceiling Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.

1. Application: Ceiling to ceiling or Wall to ceiling.

2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
3. Exposed Metal:

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

B. Elastomeric-Seal Ceiling Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Application: Ceiling to ceiling or Wall to ceiling.
2. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

3. Seal: Preformed elastomeric membranes or extrusions.

a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

2.6 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.

B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M.

2.7 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

2.8 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's standard attachment devices, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies.

C. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

D. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.

a. Shimming is not permitted.

3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

E. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

G. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

I. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.2 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.13

SECTION 079513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exterior building expansion joint cover assemblies.

B. Related Requirements:

1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.
2. Section 079100 "Preformed Joint Seals" for preformed foam and extruded-silicone joint seals.
3. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for expansion joint cover assemblies subject to vehicular traffic.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams and a tabular schedule of expansion joint cover assemblies.

C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.

1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria:

1. Type of Movement: Thermal or Wind sway.

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.

2. Type of Movement: Seismic.

a. Joint Movement: As indicated on Drawings.

2.3 EXTERIOR EXPANSION JOINT COVERS

A. Exterior Metal-Plate Joint Cover: Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.

1. Application: Wall to wall, Wall to soffit or Soffit to soffit.
2. Installation: Surface mounted.
3. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
4. Exposed Metal:

a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

B. Exterior Elastomeric-Seal Joint Cover: Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.

1. Application: Wall to wall, Wall to soffit or Soffit to soffit.

2. Installation: Surface-mounted or Recessed.
3. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
4. Exposed Metal:

    a. Aluminum: Mill, Clear anodic, Class I, Clear anodic, Class II, Color anodic, Class I, Color anodic, Class II or Manufacturer's standard.

        1) Color: Light bronze, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

5. Seal: Preformed elastomeric membrane or extrusion.

    a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

2.4 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.

B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.5 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

2.6 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's standard attachment devices, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

C. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

D. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

E. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

G. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

I. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

J. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 077129 "Manufactured Roof Expansion Joints." Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.

3.2 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.16

SECTION 079513.19 - PARKING DECK EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes parking deck expansion joint cover assemblies.

B. Related Requirements:

1. Section 079100 "Preformed Joint Seals" for preformed foam and extruded-silicone joint seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams and a tabular schedule of expansion joint cover assemblies.

C. Samples: For each expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.

C. Expansion Joint Design Criteria:

1. Type of Movement: Thermal or Wind sway.

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.

2. Type of Movement: Seismic.

a. Joint Movement: As indicated on Drawings.

2.3 PARKING DECK EXPANSION JOINT COVERS

A. Metal-Plate Parking Deck Joint Cover: Assembly consisting of metal cover plate in continuous contact with metal frames fixed to sides of joint gap.

1. Application: Slab to slab or Slab to wall.
2. Installation: Surface mounted, Recessed or No bump]
3. Load Capacity:

a. Uniform Load: 200 lb/sq. ft. (976 kg/sq. m).
b. Concentrated Load: 2000 lb (907 kg).
c. Maximum Deflection: 0.125 inch (3.2 mm).

4. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
5. Cover-Plate Design: Plain, Serrated or Abrasive covered.
6. Exposed Metal:

a. Aluminum: Mill or Manufacturer's standard.
b. Stainless steel: No. 2B, No. 4 or Manufacturer's standard.

B. Compression-Seal Parking Deck Joint Cover: Complying with ASTM E1612/E1612M. Elastomeric seal designed to always stay in compression. Install using manufacturer's recommended lubricant adhesive.

1. Application: Slab to slab or Slab to wall.
2. Load Capacity:

a. Uniform Load: 200 lb/sq. ft. (976 kg/sq. m).

b. Concentrated Load: 2000 lb (907 kg).
c. Maximum Deflection: 0.125 inch (3.2 mm).

3. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
4. Seal: Preformed elastomeric extrusion.

a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

C. Epoxy-Bonded-Seal Parking Deck Joint Cover: Elastomeric seal, epoxy-bonded to sides of joint gap. Install using manufacturer's recommended epoxy adhesive.

1. Application: Slab to slab or Slab to wall.
2. Load Capacity:

a. Uniform Load: 200 lb/sq. ft. (976 kg/sq. m).
b. Concentrated Load: 2000 lb (907 kg).
c. Maximum Deflection: 0.125 inch (3.2 mm).

3. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
4. Seal: Preformed elastomeric extrusion.

a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

D. Winged-Seal Parking Deck Joint Cover: Winged elastomeric seal grouted into block outs without mechanical attachment. Fully grout block out with manufacturer's elastomeric concrete.

1. Application: Slab to slab or Slab to wall.
2. Load Capacity:

a. Uniform Load: 200 lb/sq. ft. (976 kg/sq. m).
b. Concentrated Load: 2000 lb (907 kg).
c. Maximum Deflection: 0.125 inch (3.2 mm).

3. Fire-Resistance Rating: Not less than that indicated on Drawings, that of adjacent construction, one hour or two hours.
4. Seal: Preformed elastomeric extrusion.

a. Color: Black, Gray or as selected by Architect from manufacturer's full range.

2.4 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.

B. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.

C. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

D. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.

E. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.

F. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

2.6 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. Provide where indicated on Drawings.

B. Manufacturer's stainless-steel attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

D. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

E. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Repair or grout block out as required for continuous frame support, using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

F. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

G. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer before installing compression seals.

H. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.

I. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

J. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

K. Elastomeric Concrete: Install according to manufacturer's written application instructions.

L. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work, so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

M. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.2 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals, and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079513.19

SECTION 080152.61 - WOOD WINDOW REPAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wood window repairs as follows:

1. Repairing wood windows and trim.
2. Replacing wood window frames and sash units.
3. Reglazing.
4. Repairing, refinishing, and replacing hardware.
5. Repairing storm windows, shutters and insect screens as directed.
6. Replacing storm-window, shutter and insect-screen units as directed.
7. Providing new storm-window, shutter and insect-screen units as directed.

1.2 DEFINITIONS

A. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.

B. Window: Includes window frame, sash, hardware, storm window, and exterior and interior shutters unless otherwise indicated by context.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Wood-Window-Repair Specialist Qualifications: A qualified wood window specialist, experienced in repairing, refinishing, and replacing wood windows in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for repairing wood windows.

1. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar wood-repair applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of window-repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Window Repairs: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of wood window members including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 WOOD WINDOW REPAIRS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 6, "Interior & Exterior Millwork," in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood windows, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 6, Article 1.5, Industry Practices, of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD WINDOW UNITS

A. Replicated Wood Window Frames and Sash: Custom-fabricated replacement wood units and trim, with operating and latching hardware.

1.
2. Wood Species: Match wood species of exterior window trim and sash parts.
3. Wood Window Members and Trim: Match profiles and detail of existing window members and trim.
4. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.
5. Integral Storm and Screen Sash Inserts: Manufacturer's standard aluminum or wood-framed sash inserts as directed; with sash-insert frames recessed fully in rebates routed in window frame or sash as required; and secured with turn-button hardware. Provide insect screen for each operable exterior sash or ventilator. Shop finish sash inserts to match window frame.
6. Exposed Hardware: As directed Reuse or Match existing exposed window hardware.
7. Weather Stripping: Full-perimeter and meeting rail weather stripping for each operable sash.

2.3 STORM WINDOWS

A. General: Custom fabricated, tight fitting, replicating appearance of existing storm windows, and with operating and latching hardware.

1. Fabricate storm windows for installation on inside of primary window, on outside of primary window, matching design reference sample, matching existing location or where indicated on Drawings.
2. Fabricate storm window frame and sash so as not to be visible from the exterior or interior as directed.
3. Make storm windows removable for cleaning and storage.

B. Wood Storm Windows:
1. Wood Species: Match wood species of exterior trim and sash parts or Cedar as directed.
2. Wood Storm-Window Members: Match design reference sample, Match wood profiles of existing storm windows or As indicated on Drawings.
3. Hardware: Reuse existing unless otherwise indicated, Match design reference sample, Match existing hardware, As indicated on Drawings or As required to secure storm window to window frames.
4. Glazing Material: As directed Uncoated clear float glass or Plastic glazing.

C. Interior Aluminum Storm Windows: Fabricated from extruded aluminum to fit inside the wood window frame; finish as indicated; storm window frames concealed from exterior view.
1. Aluminum Finish: Manufacturer's standard clear anodized, light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range or as directed.
2. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range as directed.
3. Hardware: As indicated on Drawings, As required to secure storm window to window frames, Magnetic mounting or Extruded-aluminum track slides at head and sill as directed.
4. Glazing Material: As directed Uncoated clear float glass or Plastic glazing.

2.4 SHUTTERS

A. General: Stile and rail units, replicating appearance of existing units, with concealed fasteners.

B. Exterior Wood Shutters: Custom fabricated, tight fitting, and with operating and latching hardware.
1. Operation: As directed Fixed to wall, Swinging on vertical stile, Bahama or Bermuda style, out-swinging from top rail, Match design reference sample or Match existing.
2. Panel Configuration: Louvered, Flat, Raised, Match design reference sample, Match existing or As indicated on Drawings.
3. Joint Construction: As directed Mortise and tenon joints, Doweled joints, Joints matching design reference sample or Joints matching existing.
4. Wood Species: Match wood species of exterior trim and sash parts or Cedar as directed.
5. Wood Shutter Members: Match wood profiles of design reference sample, Match wood profiles of existing shutters or As indicated on Drawings.

6. Wood Preservative: Apply borate preservative treatment to accessible surfaces of exterior wood shutters before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
7. Hardware: As directed Reuse existing, Match design reference sample or Match existing hardware.

2.5 INSECT SCREENS

A. Wood Insect-Screen Frames: Custom fabricated; tight fitting and removable, replicating appearance of existing insect-screen frames, and with a minimum of exposed fasteners and latches.

1. Wood Species: As directed Match wood species of window or Cedar.
2. Insect-Screen Members: Match wood profiles of existing shutters or As indicated on Drawings.

B. Wickets: Provide sliding or hinged wickets matching insect-screen frame material and finish; framed and trimmed for a tight fit and durability during use.

C. Copper Wire Fabric: 16-by-16 count per sq. in. (1.3-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter copper wire.

D. Bronze Wire Fabric: As directed 18-by-14 count per sq. in. (1.1-by-1.5-mm) mesh of 0.009-inch- (0.23-mm-) or 0.011-inch- (0.28-mm-) diameter bronze wire with a clear varnish finish.

E. Aluminum Wire Fabric: 18-by-16 count per sq. in. (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire; natural bright, charcoal gray or black finish as directed.

2.6 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Ponderosa pine or Match species of each existing type of wood component or assembly unless otherwise indicated.

2.7 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

2.8 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Plastic Glazing: See Section 088400 "Plastic Glazing."

C. Glazing Systems:

1. Traditional Glazing Products: Glazing points and oil-based glazing putty or latex glazing compound. Tint to required color according to manufacturer's written instructions.
2. Polyurethane Glazing Products: Glazing points and single-component polyurethane glazing compound; ASTM C920, Type S, Grade NS, Class 25, Use G; struck uniformly to match taper of existing glazing system (removed); colored as required to match painted sash.
3. Silicone Glazing Products: Glazing securement and silicone glazing sealant according to Section 088000 "Glazing"; struck uniformly to match taper of existing glazing system (removed); colored as required to match painted sash.
4. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.9 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated, Cast or wrought aluminum or Nonmagnetic stainless steel unless otherwise indicated.
2. Design: As directed Custom hardware to replicate or Match type and appearance of existing hardware.
3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast-iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.
4. Spring Sash-Balance: Concealed tape-spring, spiral-tube or spring-loaded, block-and-tackle type; size and capacity to hold sash stationary at any open position as directed.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.10 WEATHER STRIPPING

A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

B. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.

C. Metal Weather Stripping: As directed Bronze or Zinc weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock; and completely concealed when window is closed.

2.11 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.

6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.12 WOOD WINDOW FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

C. Factory-Finished Units: As directed Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior wood surfaces.

1. Finish Coats: Manufacturer's standard. Match intermediate coat and topcoat products used for adjacent, repaired wood windows.
2. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399 or colors indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 WOOD WINDOW REPAIRS, GENERAL

A. Have wood window repairs performed only by qualified wood-window-repair specialist.

B. Execution of the Work: In repairing wood windows, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090190.52 "Maintenance Repainting" unless otherwise indicated.
3. Repair items in place where possible.

4. Install temporary protective measures to protect wood window work that is indicated to be completed later.
5. Refinish wood windows according to Section 090190.52 "Maintenance Repainting" unless otherwise indicated.

C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail.

D. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

E. Repair Wood Windows: Match existing materials and features.

1. Repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Sash Balance: Repair sash balances to function according to type as specified in "Hardware" Article" above. Provide missing sash balances.

F. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

G. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

H. Identify removed windows, frames, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location.

3.3 WOOD WINDOW PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids and that have limited amounts of rotted or decayed wood. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces after removing rotted or decayed wood and before applying wood consolidant or patching compound.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood window members at locations indicated on Drawings, scheduled and where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of sash frames.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated on Drawings in a schedule, and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

F. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

G. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

H. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

I. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it.

3.6 WOOD WINDOW UNIT REPLACEMENT

A. General: Replace existing wood window frame, sash, storm window and shutter units with new custom-fabricated units to match existing at locations indicated on Drawings, scheduled and where damage is too extensive to repair.

B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Mill glazed members to accommodate glass thickness. Glaze units before installation.

D. Install units level, plumb, square, true to line, without distortion or impeding movement; anchored securely in place to structural support; and in proper relation to wall flashing, trim, and other adjacent construction.

E. Set sill members in bed of sealant for weathertight construction unless otherwise indicated.

F. Install window units with new anchors into existing openings.

G. Weather Stripping: Install full-perimeter and meeting rail weather stripping for each operable sash.

H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them.

3.7 STORM WINDOW INSTALLATION

A. Install wood storm windows at each window jamb indicated.

B. Install interior aluminum storm windows at each window indicated.

3.8 SHUTTER INSTALLATION

A. Install wood shutters at each window jamb indicated.

3.9 INSECT-SCREEN INSTALLATION

A. As directed Install wood or aluminum insect-screen frames for each operable exterior sash or ventilator where indicated.

1. Locate insect-screen frames on inside or outside of window unless otherwise indicated.

B. Replace existing insect screening; remove it from Owner's property.

C. Install insect screening to be smooth, flat, and uniformly taut.

3.10 WEATHER STRIPPING INSTALLATION

A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

END OF SECTION 080152.61

SECTION 080314 - HISTORIC TREATMENT OF WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood doors in the form of the following:

1. Repairing wood doors and trim.
2. Replacing wood door Leaves and frames.
3. Reglazing.
4. Repairing, refinishing, and replacing hardware.
5. Repairing storm doors and screen doors.
6. Replacing storm-door and screen-door units.
7. Providing new storm-door and screen-door units.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures."

1.2 DEFINITIONS

A. Door: Generally, this term includes door frame, leaves, hardware, side panels or lights, fan light, transom, storm doors and screen doors unless otherwise indicated by context.

B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.

C. Interior Trim: Casing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood doors and fire protection.
2. Review methods and procedures related to historic treatment of wood doors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding door locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood door specialist, experienced in repairing, refinishing, and replacing wood doors in whole and in part. Experience only in fabricating and installing new wood doors is insufficient experience for wood-door historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Door Repair: Prepare one entire door unit to serve as mockup to demonstrate Samples of each type of repair of wood door members including frame, leaves, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood doors, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in the "Architectural Woodwork Standards," Section 12, Article 1.5, "Industry Practices," do not apply to the work of this Section.

2.2 REPLICATED WOOD DOOR UNITS

A. Replicated Wood Door Frames and Leaves: Custom-fabricated replacement wood units and trim, with operating and latching hardware.
1. Wood Species: Match wood species of existing exterior door and frame parts or White oak as directed.
2. Wood Member and Trim Profiles: Match profiles and detail of existing door members and trim.
3. Hardware: Reuse existing unless otherwise indicated, Match design reference sample, Match existing hardware, As indicated on Drawings or As required to secure storm door to door frame.
4. Hardware Set: Door Hardware Set No. as directed according to Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)."
5. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.

6. Weather Stripping: Full-perimeter weather stripping for each exterior door leaf.

2.3 STORM DOORS

A. General: Custom fabricated, tight fitting, replicating appearance of existing storm door, and with operating and latching hardware.

1. Make storm doors removable for cleaning and storage.

B. Wood Storm Doors:

1. Interchangeable Storm and Screen Inserts: As directed Equip storm-door leaf with full height or partial height panels fitting into stile-and-rail construction of storm door and secured with thumb-operable clips on storm-door to secure panels in door leaf. Storm insert shall be fully glazed with subdivided lights or single glass light and screen insert fully screened.
2. Wood Species: Match wood species of primary door and frame parts or Cedar as directed.
3. Wood Member Profiles: Match design reference sample, Match wood profiles of existing storm door or As indicated on Drawings.
4. Hardware: Reuse existing unless otherwise indicated, Match design reference sample, Match existing hardware, Three butt hinges, Three pintle-type, lift-off hinges, Thumb latch with pull, As indicated on Drawings, As required to secure storm door to door frame.
5. Hardware Set: Door Hardware Set No. as directed according to Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)."
6. Glazing Material: Uncoated clear safety glass or Plastic glazing as directed.

2.4 SCREEN DOORS

A. Wood Species: As directed Match wood species of primary door and frame parts or Cedar.

B. Wood Member Profiles: Match design reference sample, Match wood profiles of existing screen door or As indicated on Drawings.

C. Hardware: As directed Reuse existing unless otherwise indicated, Match design reference sample, Match existing hardware, Three butt hinges, Three pintle-type, lift-off hinges, Thumb latch with pull, As indicated on Drawings or As required to secure storm door to door frame.

D. Hardware Set: Door Hardware Set No. as directed according to Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)."

2.5 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.6 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated because of weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated because of weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

2.7 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Plastic Glazing: See Section 088400 "Plastic Glazing.".

C. Glazing Systems:

1. Traditional Glazing Products: Glazing points and oil-based glazing putty or latex glazing compound. Tint to required color according to manufacturer's written instructions.
2. Modern Glazing Products: Glazing points and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.
3. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.8 HARDWARE

A. Primary Door Hardware, General: Provide complete sets of door hardware consisting of hinges, pulls, locks, latches, and accessories indicated for each door or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Door hardware shall smoothly operate, tightly close, and securely lock wood doors and be sized to accommodate frequency of use, glazing weight, and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated or Nonmagnetic stainless steel unless otherwise indicated.
2. Design: As directed Custom hardware to replicate or Match type and appearance of existing hardware.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.9 WEATHER STRIPPING

A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when door is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

B. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.

C. Metal Weather Stripping: As directed Bronze or Zinc weather stripping; designed either as one piece to seal door at head and jambs by door sliding against it or as two pieces that interlock; and completely concealed when door is closed.

2.10 MISCELLANEOUS MATERIALS

A. Insect Screening:

1. Copper Wire Fabric: 16-by-16 count per sq. in. (1.3-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter copper wire.
2. Bronze Wire Fabric: As directed 18-by-14 count per sq. in. (1.1-by-1.5-mm) mesh of 0.009-inch- (0.23-mm-) or 0.011-inch- (0.28-mm-) diameter bronze wire with a clear varnish finish.
3. Aluminum Wire Fabric: 18-by-16 count per sq. in. (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire; natural bright, charcoal gray or black finish as directed.

B. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

C. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.

2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

D. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure conditions.

E. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

F. Anchors, Clips, and Accessories: Fabricate anchors, clips, and door accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.11 WOOD DOOR FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

C. Factory-Finished Units: As directed Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior wood surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."
2. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated on Historic Structure Report or colors indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood doors of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas

with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood doors to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood door work that is indicated to be completed later.
5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle door hardware; strip paint, repair, and refinish it to match finish Samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood Doors: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood doors by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood doors by limited replacement matching existing material.

E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Protection of Openings: Where doors are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed doors, frames, leaves, and members with numbering system corresponding to door locations to ensure reinstallation in same location.

3.3 WOOD DOOR PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids and that have limited amounts of rotted or decayed wood.

1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD DOOR MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood door members at locations indicated on Drawings, scheduled and where damage is too extensive to patch.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of door frames.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter weather stripping for each exterior leaf.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing system, and glazing materials, unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated on Drawings in a schedule, and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

F. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

G. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

H. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

I. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD DOOR UNIT REPLACEMENT

A. General: As directed Replace existing wood door frame, leaf, storm door and screen door units with new custom-fabricated units to match existing at locations indicated on Drawings, scheduled and where damage is too extensive to repair.

B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Mill glazed members to accommodate glass thickness. Glaze units before installation.

D. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing, trim, and other adjacent construction.

E. Set threshold or sill members in bed of sealant for weathertight construction unless otherwise indicated.

F. Install door units with new anchors into existing openings.

G. Weather Stripping: Install full-perimeter weather stripping for each operable exterior leaf.

H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

3.7 STORM DOOR INSTALLATION

A. Fit wood storm doors at each door jamb indicated. Verify that storm door and door frames are correctly tagged with opening-identification numbers.

B. Adjust hardware, clips, and removable fasteners for a tight fit with uniform joints. Uninstall and reinstall door at least once to ensure proper fit.

C. Install and leave storm doors in place when directed by Architect to suit the season.

3.8 SCREEN DOOR INSTALLATION

A. Fit wood screen doors at each door jamb indicated. Verify that screen door and door frames are correctly tagged with opening-identification numbers.

B. Adjust hardware, clips, and removable fasteners for a tight fit with uniform joints. Uninstall and reinstall door at least once to ensure proper fit.

C. Install and leave screen doors in place when directed by Architect to suit the season.

D. Replace existing insect screening where indicated; remove it from Owner's property.

E. Install insect screening to be smooth, flat, and uniformly taut.

3.9 WEATHER STRIPPING INSTALLATION

A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

END OF SECTION 080314

SECTION 080351.23 - HISTORIC TREATMENT OF STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of steel windows in the form of the following:

1. Repairing steel windows and trim.
2. Repairing steel subframes uncovered by removal of window frames.
3. Replacing steel windows and sash units.
4. Reglazing.
5. Repairing, refinishing, and replacing hardware.
6. Repairing insect screens.
7. Replacing insect-screen units.
8. Providing new storm windows.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 01351 "Special Procedures for Historic Treatment"

1.2 DEFINITIONS

A. Window: Includes window frame, sash, hardware, and insect screens unless otherwise indicated by context.

B. Subframe: Steel window anchorage, usually built into wall construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic treatment of steel windows at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of steel windows and fire protection.
2. Review methods and procedures related to historic treatment of steel windows.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic steel window specialist, experienced in repairing, refinishing, and replacing steel windows in whole and in part. Experience only in fabricating and installing new steel windows is insufficient experience for steel window historic treatment work.

B. Steel-Patching-Compound Manufacturer Qualifications: A firm regularly engaged in producing steel-patching compound that has been used for similar historic-metal-repair applications with successful results.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Steel Window Repair: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of steel window members, including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 REPLICATED STEEL WINDOW UNITS

A. Replicated Steel Window Frames and Sash: Replacement, welded-steel units matching existing units; custom fabricated from salvaged windows, new steel shapes, or a combination thereof; and with operating and latching hardware.

1. Manufacturers: Subject to compliance with requirements, provide products fabricated by the historic treatment specialist firms.
2. Exposed Hardware: As directed Reuse or Match existing exposed window hardware.
3. Weather Stripping: One or Full-perimeter weather stripping for each operable sash Where indicated.

2.2 STORM WINDOWS

A. General: Custom fabricated, tight fitting to opening, and with operating and latching hardware.

1. Fabricate storm windows for installation inside of primary window and where indicated on Drawings.
2. Hardware: Match design reference sample, Match existing or As shown on Drawings as directed.
3. Glazing Material: Uncoated clear float glass or Plastic glazing as directed.

B. Interior Aluminum Storm Windows: Fabricated from extruded aluminum to fit inside the window opening; finish as indicated; storm window frames not easily visible from exterior side of primary window.

1. Aluminum Finish: Manufacturer's standard clear anodized, light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range as directed.
2. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range as directed.
3. Hardware: As indicated on Drawings or As required to secure storm window to window opening or Extruded-aluminum track slides at head and sill.

2.3 INSECT SCREENS

A. Insect-Screen Frame: As directed Formed sheet steel, custom fabricated or salvaged or Custom-fabricated, extruded-aluminum unit, replicating appearance of existing insect-screen frames, that fits over and aligns with interior surface of steel window frame and screens the entire operable-sash opening; tight fitting against surface of window frame and removable; with a minimum of exposed fasteners and latches; and with wire fabric screening indicated below; finish as indicated; concealed from exterior view.

1. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
2. Aluminum Finish: Manufacturer's standard As directed light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range as directed.

B. Screening: Copper, Bronze or Aluminum wire fabric as directed.

2.4 STEEL-REPAIR MATERIALS

A. Steel: Steel shapes from salvage sources or new steel plate, shapes, and bars. Use available salvage sources before using new steel materials.

B. Steel-Patching Compound: Two-part, metal-filled epoxy resin, steel-patching compound; knife-grade formulation as recommended in writing by manufacturer for types of repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated due to corrosion. Filler shall be capable of filling deep holes and spreading to featheredge.

1. Source Limitations: Obtain steel-patching compound from single source from single manufacturer.

2.5 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Plastic Glazing: See Section 088400 "Plastic Glazing.".

C. Glazing Systems:

1. Traditional Glazing Products: Glazing clips and oil-based glazing putty or latex glazing compound.
2. Modern Glazing Products: Glazing clips and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.
3. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.6 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock steel windows and be sized to accommodate sash weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with hardware from salvage sources or newly manufactured hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated, Cast or wrought aluminum or Nonmagnetic stainless steel unless otherwise indicated.
2. Design: As directed Custom hardware to replicate or Match type and appearance of existing hardware.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.7 WEATHER STRIPPING MATERIALS

A. Sealant: Multicomponent, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, for Use NT; color to match window frame.

B. Bond-Breaker Strip: Polyethylene tape or other plastic tape to which sealant does not adhere, as recommended in writing by sealant manufacturer; width as required to fully cover mating joint between sash and frame.

2.8 MISCELLANEOUS MATERIALS

A. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.

B. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anti-corrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29.

1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning", SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" surface preparation according to manufacturer's literature or certified statement.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type unless otherwise indicated.
2. Use concealed fasteners to attach items to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
4. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of nonmagnetic stainless steel or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.9 STEEL WINDOW FINISHES

A. Shop-Primed Replacement Units: Manufacturer's standard shop-prime coat on exposed surfaces; compatible with indicated finish coating.

B. Site-Finished Units: High-performance, pigmented polyurethane-over-epoxy system, Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."

C. Shop-Finished Units: Baked-enamel or powder-coated, High-performance, pigmented polyurethane-over-epoxy system, Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."

D. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated on Historic Structure Report or colors indicated on Drawings as directed.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF STEEL WINDOWS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair steel windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Clean steel windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
3. Remove coatings from accessible surfaces according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
4. Repair items in place where possible, unless otherwise indicated.
5. Repaint historic steel windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Steel Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair steel windows by patching, splicing, or otherwise reinforcing steel with new or salvaged steel members.
2. Where indicated, repair steel windows by limited replacement matching existing material.

E. Replace Steel Units: Where indicated, duplicate and replace units with units made from salvaged, sound, steel windows and their components or with new steel shapes matching size and form of existing shapes.

F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed windows, frames, sash, and components with numbering system corresponding to window locations to ensure reinstallation in same location.

3.2 STEEL WINDOW STRAIGHTENING

A. Remove glass, weather stripping, and interfering hardware from sash. Remove paint buildup from between sash and frame.

B. Using shims and gentle pressure, align and straighten sash and frame to close completely and snugly against each other, around entire perimeter of sash.

C. Straighten and adjust hinges, latches, and other hardware so that sash and frame remain snugly against each other along entire perimeter of sash in closed and latched position.

3.3 RUST REMOVAL

A. Chemical Rust Removal:

1. Remove loose rust scale with tools and abrasives to sound metal or firmly adhered rust residue. Vacuum debris from cavities.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

B. Mechanical Rust Removal:

1. Remove rust with tools and abrasives. Vacuum debris from cavities.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

C. In-Shop Rust and Paint Removal: Remove rust and paint in shop by chemical or mechanical methods, sandblasting or dipping in chemical bath as directed.

1. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
2. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.4 STEEL WINDOW PATCH-TYPE REPAIR

A. General: Patch steel members that exhibit depressions, nonstructural holes, and corrosion.

B. Remove rust down to sound, rust-free material.

C. Apply steel-patching compound to fill depressions, nicks, cuts, and other voids created by rusted, removed, or missing steel.

1. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
2. Finish patch surface smooth and flush with adjacent steel, without voids in patch material, and matching contour of steel member.

D. Verify that patch repairs do not interfere with snug fit of sash and frame against each other along entire perimeter of sash in closed and latched position. If not, modify the patch repair or restraighten window as required.

3.5 STEEL WINDOW MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire steel window members at locations indicated on Drawings, scheduled and where damage is too extensive to patch as directed.

1. Straighten window as specified in "Steel Window Straightening" Article.
2. Remove rust and broken steel down to sound, rust-free material.

3. Cut out structurally weakened sections.
4. Custom fabricate new steel of same size, thickness, and shape as cut-out material to replace missing steel; either replace entire steel member or splice new steel part into existing member.
5. Weld or braze replacement material in place, and grind the repair smooth and flush with adjoining metal or filled metal as applicable.
6. If replacement metal sections of original cross section cannot be found from salvage sources, weld flat plates into a built-up section.

B. Repair remaining depressions, holes, or similar voids with patch-type repairs.

C. Glazing: Provide replacement glazing clips coordinated with glazing system indicated.

D. Reinstall units removed for repair into original openings.

E. Verify that member-replacement repairs do not interfere with snug fit of sash and frame against each other along entire perimeter of sash in closed and latched position. If not, modify the member-replacement repair or restraighten window as required.

3.6 SHOP REPAIR OF WINDOWS FRAMES AND SUBFRAME REPAIR

A. Remove window frames where indicated and sash from wall before performing window straightening, rust removal, patch-type repairs, and member-replacement repairs as required.

B. Remove rust in shop.

C. Subframe: On site, examine subframe exposed by window frame removal, and remove rust from exposed subframe.

1. Surface Preparation: Remove paint, rust, and other contaminants according to coating manufacturer's written instructions.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry-film thickness per coat).

D. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

3.7 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing system, and glazing materials unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings, and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated, and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Prime steel, including glazing rabbets, with finish-paint primer before installing glass.

F. Size glass as required by Project conditions to provide necessary bite on glass and minimum edge and face clearances with reasonable tolerances.

G. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

H. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

I. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

J. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.8 STEEL WINDOW UNIT REPLACEMENT

A. General: Replace existing window frame and sash units with replicated steel units to match existing at locations scheduled and where damage is too extensive to repair.

B. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

D. Anchor Concealment: Fill screw head depressions flush and smooth with paintable putty after window installation, spot prime, and paint.

E. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

3.9 STORM WINDOW INSTALLATION

A. Install interior aluminum storm windows at each window opening indicated.

3.10 INSECT-SCREEN INSTALLATION

A. Install insect screen for each outward-acting sash or where indicated.

1. Locate insect-screen frames on inside of window.
2. Install insect-screen frames by securing with metal twist clips to window frame.

B. Replace existing insect screening; remove it from Owner's property.

C. Install insect screening to be smooth, flat, and uniformly taut.

3.11 WEATHER STRIPPING INSTALLATION

A. General: Install weather stripping for tight seal between sash and frame as determined by preconstruction testing and demonstrated in mockup.

B. Application: Apply continuous bead of sealant to window frame surface against which sash frame closes. Cover applied sealant with bond-breaker strip, fully close sash, and latch in closed position. Remove extruded sealant if any.

C. Curing: Allow sealant to cure in closed-window joint for 28 days unless otherwise recommended in writing by sealant manufacturer.

D. Removing Bond-Breaker Strip: After curing time, gently open window and remove bond-breaker strip. Verify that weather stripping is continuous and neat, without spillage on other surfaces. Remove spillage if any. Wipe down joint sides with damp cloth and close sash. Verify full closure.

END OF SECTION 080351.23

SECTION 080351.33 - HISTORIC TREATMENT OF ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of aluminum windows as follows:

1. Cleaning aluminum surfaces.
2. Repairing and refinishing aluminum windows and trim.
3. Replacing aluminum windows and sash unit.
4. Repairing steel anchors uncovered by removing window frames.
5. Reglazing.
6. Repairing, refinishing, and replacing hardware.
7. Repairing insect screens.
8. Replacing insect-screen units.
9. Providing new add-on storm windows.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Window: Includes window frame, sash, hardware, and insect screens unless otherwise indicated by context.

B. Subframe: Steel or aluminum anchorage, usually built into wall construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of aluminum windows.
2. Review methods and procedures related to historic treatment of aluminum windows.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications:

1. Repair Specialist: A qualified historic aluminum window specialist, experienced in repairing, refinishing, and replacing metal windows in whole and in part. Experience only in fabricating and installing new metal windows is insufficient experience for aluminum window historic treatment work.
2. Refinishing Specialist: A qualified historic aluminum window specialist, experienced in refinishing aluminum windows in whole and in part. Refinishing specialist shall coordinate with the work of the repair specialist.

B. Aluminum-Patching-Compound Manufacturer Qualifications: A firm regularly engaged in producing aluminum-patching compound that has been used for similar historic-metal-repair applications with successful results.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Locate mockups on existing windows where directed by Architect or in locations that enable viewing under same conditions as the completed Work as directed.
2. Aluminum Window Repair: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of aluminum window members, including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 REPLICATED ALUMINUM WINDOW UNITS

A. Replicated Aluminum Window Frames and Sash: Replacement aluminum units matching existing units; custom fabricated from salvaged windows, new aluminum extrusions and shapes, or a combination thereof; and with operating and latching hardware; finished to match existing windows.
1. Exposed Hardware: As directed Reuse or Match existing exposed window hardware.
2. Weather Stripping: Full-perimeter weather stripping for each operable sash.

2.2 STORM WINDOWS

A. Description: Custom fabricated, tight fitting to opening, and with operating and latching hardware.

1. Hardware: Match design reference sample, Match existing or As indicated on Drawings.
2. Glazing Material: As directed Uncoated clear float glass or Plastic glazing.

B. Replacement, Integral Storm Sash: Aluminum unit, replicating appearance of existing storm sash, that fits within existing storm-window track of window frame and aligns with operable-sash opening; snug fitting with pile of other closure against perimeter of sash opening and removable; finish as indicated.

C. Add-on Storm Windows: Fabricated to fit inside the window opening, and thermally separated from contact with primary window frame; finish as indicated; storm window frames not easily visible from exterior side of primary window.
   1. Fabricate add-on storm windows for installation inside of primary window and where indicated on Drawings.
   2. Hardware: As indicated on Drawings or As required to secure storm window to window opening as directed.

D. Aluminum Finish: Manufacturer's standard clear anodized, light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range as directed.

E. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range as directed.

2.3 INSECT SCREENS

A. Insect-Screen Frame for Projecting Sash: Aluminum unit, replicating appearance of existing insect-screen frame, that fits over and aligns with interior surface of aluminum window frame and screens the entire operable-sash opening; tight fitting against surface of window frame and removable; with a minimum of exposed fasteners and latches; with removable splines or continuous bar to secure screening; and with wire fabric screening indicated below; finish as indicated; concealed from exterior view.

B. Insect-Screen Frame for Hung Sash: Aluminum unit, replicating appearance of existing insect-screen frame, that fits within existing screen track of window frame and aligns with operable-sash opening; snug fitting with pile of other closure against perimeter of sash opening and removable; with removable splines or continuous bar to secure screening; and with wire fabric screening indicated below; finish as indicated.

C. Aluminum Finish: Manufacturer's standard light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range as directed.

D. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range as directed.

E. Screening: Aluminum or stainless-steel wire fabric.

2.4 ALUMINUM-REPAIR MATERIALS

A. Aluminum: Aluminum extrusions or shapes from salvage sources or new extrusions, forgings, and castings. Use available salvage sources before using new aluminum materials. Use alloy and temper recommended in writing by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum-Patching Compound: Two-part, metal-filled epoxy resin, aluminum-patching compound; knife-grade formulation as recommended in writing by manufacturer for types of repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion or abuse. Filler shall be capable of filling deep holes and spreading to featheredge.

1. Source Limitations: Obtain aluminum-patching compound from single source from single manufacturer.

2.5 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing.".

B. Plastic Glazing: See Section 088400 "Plastic Glazing.".

C. Glazing-Stop System: As directed Existing, Replicated or Modified aluminum window stops, finished to match window sash, and mechanically attached at equal intervals maximum 12 inches (300 mm) o.c.; with mitered corners and butyl glazing tape complying with ASTM C1281 and AAMA 800 on both sides of glass.

2.6 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock aluminum windows and be sized to accommodate sash weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with hardware from salvage sources or newly manufactured hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated, Cast or wrought aluminum, Nonmagnetic stainless steel unless otherwise indicated.
2. Design: As directed Custom hardware to replicate or Match type and appearance of existing hardware.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.7 MISCELLANEOUS MATERIALS

A. Detergent Solution: Prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 as directed.

1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning", SSPC-SP 3, "Power Tool Cleaning" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" surface preparation according to manufacturer's literature or certified statement as directed.

C. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type unless otherwise indicated.
2. Use concealed fasteners to attach items to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
4. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

D. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of nonmagnetic stainless steel or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.8 PAINTED ALUMINUM WINDOW FINISHES

A. Shop-Primed Replacement Units: Manufacturer's standard shop-prime coat on exposed surfaces; compatible with indicated finish coating.

B. Site-Finished Units: High-performance, pigmented polyurethane-over-epoxy system, Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."

C. Shop-Finished Units: Baked-enamel or powder-coated High-performance, pigmented polyurethane-over-epoxy system, Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."

D. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated on Historic Structure Report or colors indicated on Drawings.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF ALUMINUM WINDOWS, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Clean aluminum windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with a natural bristle brush or sponge and detergent solution. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
2. Stabilize and repair aluminum windows to maintain and reestablish structural integrity and weather resistance while maintaining the existing form of each item.
3. Repair items in place where possible unless otherwise indicated.
4. As directed Paint or Repaint historic aluminum windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as indicated as part of historic treatment program and as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; lubricate moving parts just enough to function smoothly.

D. Repair Aluminum Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair aluminum windows by patching, splicing, or otherwise reinforcing aluminum with new or salvaged aluminum members.
2. Where indicated, repair aluminum windows by limited replacement matching existing material.

E. Replace Aluminum Units: Where indicated, duplicate and replace units with units made from salvaged, sound, aluminum windows and their components or with new aluminum extrusions and shapes matching size and form of existing extrusions and shapes.

F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed windows, frames, sash, and components with numbering system corresponding to window locations to ensure reinstallation in same location.

3.2 REMOVING CHALKING APPEARANCE ON ANODIZED ALUMINUM

A. Perform cleaning as required in "Historic Treatment of Aluminum Windows, General" Article.

B. Perform additional cleaning at places where chalking remains. Perform this work as determined by preconstruction testing and demonstrated in mockup.

3.3 ALUMINUM WINDOW STRAIGHTENING

A. Remove glass, detachable weather stripping, and interfering hardware from sash. Remove dirt and paint buildup from between sash and frame.

B. Using shims and gentle pressure, align and straighten sash and frame to close completely and uniformly against each other, allowing for uniform thickness of detachable weather stripping, if any, around entire perimeter of sash.

C. Straighten and adjust hinges, latches, and other hardware so that sash and frame in closed and latched position will remain completely and uniformly against each other allowing for uniform thickness of detachable weather stripping, if any, around entire perimeter of sash.

D. Reinstall detachable weather stripping, and verify complete and continuous seal around entire perimeter of sash in closed and latched position.

3.4 ALUMINUM WINDOW PATCH-TYPE REPAIR

A. Description: Patch aluminum members that exhibit depressions, nonstructural holes, pitting, and deep corrosion.

B. Remove corrosion down to sound material.

C. Apply aluminum-patching compound to fill depressions, nicks, cuts, and other voids created by corroded, removed, or missing aluminum.

1. Apply patching compound in layers, as recommended in writing by manufacturer, until the void is completely filled.
2. Finish patch surface smooth and flush with adjacent aluminum, without voids in patch material, and matching contour of aluminum member.

D. Verify that patch repairs do not interfere with snug fit of sash and frame against each other along entire perimeter of sash in closed and latched position. If not, modify the patch repair or restraighten window as required.

3.5 ALUMINUM WINDOW MEMBER-REPLACEMENT REPAIR

A. Description: Replace parts of or entire aluminum window members at locations indicated on Drawings, scheduled and where damage is too extensive to patch as directed.

1. Straighten window as specified in "Aluminum Window Straightening" Article.
2. Remove deep corrosion and broken members down to sound, corrosion-free material.
3. Cut out structurally weakened sections.
4. Custom fabricate new aluminum of same size, thickness, and shape as removed and cut-out material to replace missing aluminum; either replace entire aluminum member or splice new aluminum part into existing member.
5. Weld, braze, or mechanically fasten replacement material in place, and grind the repair smooth and flush with adjoining metal or filled metal as applicable. Use welding, brazing, or mechanical attachment that matches method of connecting original members.

6. If replacement metal sections of original cross section cannot be found from salvage sources, use custom extrusions or aluminum members welded together into a built-up section.

B. Repair remaining depressions, holes, or similar voids with patch-type repairs.

C. Glazing: Provide replacement glazing stops coordinated with glazing system indicated.

D. Reinstall units removed for repair into original openings.

E. Verify that member-replacement repairs do not interfere with snug fit of sash and frame against each other along entire perimeter of sash in closed and latched position. If not, modify the member-replacement repair or restraighten window as required.

3.6 SHOP REPAIR OF WINDOWS FRAMES

A. Remove window frames where indicated and sash from wall before performing window straightening, corrosion removal, patch-type repairs, member-replacement repairs, and refinishing, as required.

B. Remove aluminum pitting and deeper corrosion in shop.

C. Perform other required historic treatment work.

3.7 ON-SITE STEEL-ANCHOR REPAIR

A. Examine anchors exposed by window frame removal. Protect adjacent materials and remove rust.

1. Prepare and paint exposed anchors on-site as follows:

a. Surface Preparation: Remove paint, rust, and other contaminants according to coating manufacturer's written instructions.
b. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry-film thickness per coat).

B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

3.8 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing system, and glazing materials unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated, and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Prime aluminum, including glazing rabbets, with finish-paint primer before installing glass.

F. Size glass as required by Project conditions to provide necessary bite on glass and minimum edge and face clearances with reasonable tolerances.

G. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

H. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

I. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

J. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.9 ALUMINUM WINDOW UNIT REPLACEMENT

A. Description: Replace existing window frame and sash units with replicated aluminum units to match existing at locations indicated on Drawings, scheduled and where damage is too extensive to repair as directed.

B. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

D. Anchor Concealment: Fill screw head depressions flush and smooth with paintable putty after window installation, spot prime, and paint.

E. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

3.10 STORM WINDOW INSTALLATION

A. Install integral storm sash in existing storm-window tracks of primary window at each window opening indicated.

B. Install add-on storm windows at each window opening indicated.

3.11 INSECT-SCREEN INSTALLATION

A. Install insect screen for each outward-acting sash where indicated.

1. Locate insect-screen frames on inside of window.
2. Install insect-screen frames by securing with metal twist clips to window frame.

B. Replace existing insect screening; remove it from Owner's property.

C. Install insect screening to be smooth, flat, and uniformly taut.

END OF SECTION 080351.33

SECTION 080352 - HISTORIC TREATMENT OF WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood windows in the form of the following:

1. Repairing wood windows and trim.
2. Replacing wood window frames and sash units.
3. Reglazing.
4. Repairing, refinishing, and replacing hardware.
5. Repairing storm windows, shutters and insect screens.
6. Replacing storm-window, shutter and insect-screen units.
7. Providing new storm-window, shutter and insect-screen units.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Window: Includes window frame, sash, hardware, trim, storm window, and exterior and interior shutters unless otherwise indicated by context.

B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.

C. Interior Trim: Casing, stool, and apron.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood windows and fire protection.
2. Review methods and procedures related to historic treatment of wood windows.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

C. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist, experienced in repairing, refinishing, and replacing wood windows in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for wood-window historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

1. Wood Window Repair: Prepare one entire window unit to serve as mockup to demonstrate samples of each type of repair of wood window members including frame, sash, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood windows, and other requirements unless otherwise indicated.

1. Exception: Industry practices cited in Section 12, Article 1.5, Industry Practices, of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD WINDOW UNITS

A. Replicated Wood Window Frames and Sash: Custom-fabricated replacement wood units and trim, with operating and latching hardware.
1. Wood Species: Match wood species of exterior window trim and sash parts.
2. Wood Window Members and Trim: Match profiles and detail of existing window members and trim.
3. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.
4. Integral, Storm and Screen Sash Inserts: Manufacturer's standard aluminum or wood-framed sash inserts; sash-insert frames recessed fully in rebates routed in window frame

or sash as required; and secured with turn-button hardware. Provide insect screen for each operable exterior sash or ventilator. Shop finish sash inserts to match window frame.

5. Exposed Hardware: as directed Reuse or Match existing exposed window hardware.
6. Weather Stripping: Full-perimeter and meeting rail weather stripping for each operable sash.

2.3 STORM WINDOWS

A. General: Custom fabricated, tight fitting, replicating appearance of existing storm windows, and with operating and latching hardware.

1. Fabricate storm windows for installation on inside of primary window, on outside of primary window, matching design reference sample, matching existing location or where indicated on Drawings.
2. Fabricate storm window frame and sash so as not to be visible from the exterior or interior as directed.
3. Make storm windows removable for cleaning and storage.

B. Wood Storm Windows:
1. Wood Species: As directed Match wood species of exterior trim and sash parts or Cedar.
2. Wood Storm-Window Members: Match design reference sample, Match wood profiles of existing storm windows or As indicated on Drawings.
3. Hardware: Reuse existing unless otherwise indicated, Match design reference sample, Match existing hardware, As indicated on Drawings or As required to secure storm window to window frames.
4. Glazing Material: As directed Uncoated clear float glass or Plastic glazing.

C. Interior Aluminum Storm Windows: Fabricated from extruded aluminum to fit inside the wood window frame; finish as indicated; storm window frames concealed from exterior view.
1. Aluminum Finish: Manufacturer's standard clear anodized, light bronze anodized, medium bronze anodized, dark bronze anodized, anodized color matching design reference sample, anodized color matching Architect's sample or anodized color as selected by Architect from manufacturer's full range as directed.
2. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching design reference sample, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
3. Hardware: As indicated on Drawings, As required to secure storm window to window frames or Extruded-aluminum track slides at head and sill as directed.
4. Glazing Material: Uncoated clear float glass or Plastic glazing as directed.

2.4 SHUTTERS

A. General: Stile and rail units, replicating appearance of existing units, with concealed fasteners.

B. Exterior Wood Shutters: Custom fabricated, tight fitting, and with operating and latching hardware.
1. Operation: Fixed to wall, Swinging on vertical stile, Bahama or Bermuda style, out-swinging from top rail, Match design reference sample or Match existing as directed.

2. Panel Configuration: Louvered, Flat, Raised, Match design reference sample, Match existing or As indicated on Drawings.
3. Joint Construction: As directed Mortise and tenon joints, Doweled joints, Joints matching design reference sample or Joints matching existing.
4. Wood Species: As directed Match wood species of exterior trim and sash parts or Cedar.
5. Wood Shutter Members: As directed Match wood profiles of design reference sample, Match wood profiles of existing shutters or As indicated on Drawings.
6. Wood Preservative: Apply borate preservative treatment to accessible surfaces of exterior wood shutters before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
7. Hardware: Reuse existing, Match design reference sample or Match existing hardware as directed.

2.5 INSECT SCREENS

A. Wood Insect-Screen Frames: Custom fabricated; tight fitting and removable, replicating appearance of existing insect-screen frames, and with a minimum of exposed fasteners and latches.

1. Wood Species: As directed Match wood species of window or Cedar.
2. Insect-Screen Members: As directed Match wood profiles of existing shutters or As indicated on Drawings.

B. Wickets: Provide sliding or hinged wickets matching insect-screen frame material and finish; framed and trimmed for a tight fit and durability during use.

C. Copper Wire Fabric: 16-by-16 count per sq. in. (1.3-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter copper wire.

D. Bronze Wire Fabric: 18-by-14 count per sq. in. (1.1-by-1.5-mm) mesh of 0.009-inch- (0.23-mm-) or 0.011-inch- (0.28-mm-) diameter bronze wire with a clear varnish finish as directed.

E. Aluminum Wire Fabric: 18-by-16 count per sq. in. (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire; natural bright, charcoal gray or black finish.

2.6 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.7 WOOD-REPAIR MATERIALS

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

2.8 GLAZING MATERIALS

A. Glass: See Section 088000 "Glazing."

B. Plastic Glazing: See Section 088400 "Plastic Glazing."

C. Glazing Systems:

1. Traditional Glazing Products: Glazing points and oil-based glazing putty or latex glazing compound. Tint to required color according to manufacturer's written instructions.
2. Modern Glazing Products: Glazing points and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.
3. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.9 HARDWARE

A. Window Hardware: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.

C. Material and Design:

1. Material: Solid bronze of alloy indicated, Cast or wrought aluminum or Nonmagnetic stainless steel unless otherwise indicated.
2. Design: Custom hardware to replicate or Match type and appearance of existing hardware.
3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.
4. Spring Sash-Balance: Concealed tape-spring, spiral-tube or spring-loaded, block-and-tackle type; size and capacity to hold sash stationary at any open position as directed.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.10 WEATHER STRIPPING

A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

B. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.

C. Metal Weather Stripping: As directed Bronze or Zinc weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock; and completely concealed when window is closed.

2.11 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.

3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.12 WOOD WINDOW FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

C. Factory-Finished Units: As directed Alkyd or Latex finish system consisting of primer and two finish coats on exposed exterior and interior wood surfaces.

1. Finish Coats: Manufacturer's standard. As specified in Section 090391 "Historic Treatment of Plain Painting."
2. Color and Gloss: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated on Historic Structure Report or colors indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

A. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.

2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood window work that is indicated to be completed later.
5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.

C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

D. Repair Wood Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood windows by limited replacement matching existing material.
3. Sash Balance: Repair sash balances to function according to type as specified in "Hardware" Article" above. Provide missing sash balances.

E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

G. Identify removed windows, frames, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location.

3.3 WOOD WINDOW PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids, and that have limited amounts of rotted or decayed wood.

1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood window members at locations indicated on Drawings, scheduled and where damage is too extensive to patch as directed.

1. Remove broken, rotted, and decayed wood down to sound wood.
2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Glazing: Reglaze units before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of sash frames.

E. Reinstall units removed for repair into original openings.

F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.5 GLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated on Drawings in a schedule, and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

F. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

G. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

H. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

I. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD WINDOW UNIT REPLACEMENT

A. General: As directed Replace existing wood window frame, sash, storm window and shutter units with new custom-fabricated units to match existing at locations indicated on Drawings, scheduled and where damage is too extensive to repair.

B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Mill glazed members to accommodate glass thickness. Glaze units before installation.

D. Install units level, plumb, square, true to line, without distortion or impeding movement; anchored securely in place to structural support; and in proper relation to wall flashing, trim, and other adjacent construction.

E. Set sill members in bed of sealant for weathertight construction unless otherwise indicated.

F. Install window units with new anchors into existing openings.

G. Weather Stripping: Install full-perimeter and meeting rail weather stripping for each operable sash.

H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

3.7 STORM WINDOW INSTALLATION

A. Install wood storm windows at each window jamb indicated.

B. Install interior aluminum storm windows at each window indicated.

3.8 SHUTTER INSTALLATION

A. Install wood shutters at each window jamb indicated.

3.9 INSECT-SCREEN INSTALLATION

A. Install wood or aluminum insect-screen frames for each operable exterior sash or ventilator where indicated.

1. As directed Locate insect-screen frames on inside or outside of window unless otherwise indicated.

B. Replace existing insect screening; remove it from Owner's property.

C. Install insect screening to be smooth, flat, and uniformly taut.

3.10 WEATHER STRIPPING INSTALLATION

A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

END OF SECTION 080352

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames.
4. Exterior custom hollow-metal doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: As directed Where indicated on Drawings or At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. (2.84 W/K x sq. m), 0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) or 0.38 deg Btu/F x h x sq. ft. (2.16 W/K x sq. m) when tested according to ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: SDI A250.8, Level 1; SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: as directed 1-3/4 inches (44.5 mm) or 1-3/8 inches (34.9 mm).
c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.032 inch (0.8 mm).
d. Edge Construction: As directed Model 1, Full Flush or Model 2, Seamless.
e. Core: As directed Manufacturer's standard, Kraft-paper honeycomb, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
f. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.

C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: As directed Model 1, Full Flush or Model 2, Seamless.
e. Core: As directed Manufacturer's standard, Kraft-paper honeycomb, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
f. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. As directed Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded

D. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: As directed Uncoated, Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    d. Edge Construction: As directed Model 1, Full Flush, Model 2, Seamless or Model 3, Stile and Rail.
    e. Core: As directed Manufacturer's standard, Kraft-paper honeycomb, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
    f. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

    a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.

E. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
    d. Edge Construction: As directed Model 1, Full Flush or Model 2, Seamless.
    e. Core: As directed Manufacturer's standard, Kraft-paper honeycomb, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
    f. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

    a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum As directed A40 (ZF120) or A60 (ZF180) coating.
d. Edge Construction: As directed Model 1, Full Flush or Model 2, Seamless.
e. Edge Bevel: As directed Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm), Bevel lock edge 1/8 inch in 2 inches (3.2 mm in 51 mm) or Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: As directed Manufacturer's standard, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
i. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener with insulation or laminated mineral board core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) or A60 (ZF180) coating as directed.
b. Construction: As directed Knocked down, Face welded or Full profile welded.

C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum As directed A40 (ZF120) or A60 (ZF180) coating.
d. Edge Construction: As directed Model 1, Full Flush, Model 2, Seamless or Model 3, Stile and Rail.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.

g. Core: As directed Manufacturer's standard, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
h. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation or laminated mineral board core for fire-rated doors as directed.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) or A60 (ZF180) coating as directed.
b. Construction: As directed Knocked down, Face welded or Full profile welded.

D. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum A40 (ZF120) or A60 (ZF180) coating as directed.
d. Edge Construction: As directed Model 1, Full Flush or Model 2, Seamless.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: As directed Manufacturer's standard, Polystyrene, Polyurethane, Polyisocyanurate or Vertical steel stiffener.
h. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener with insulation or laminated mineral board core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum A40 (ZF120) or A60 (ZF180) coating as directed.
b. Construction: As directed Knocked down, Face welded or Full profile welded.

2.5 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).

c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.032 inch (0.8 mm), 0.042 inch (1.0 mm) or 0.053 inch (1.3 mm).
d. Edge Construction: As directed Continuously welded with no Projection or tack welded with no Interlocking with Projection or tack welded with visible seam.
e. Core: Steel stiffened.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.

B. Commercial Doors and Frames: NAAMM-HMMA 861; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Continuously welded with no visible seam.
e. Core: Steel stiffened.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), except 0.067 inch (1.7 mm) for openings exceeding4 feet (1219 mm) wide.
b. As directed Sidelite and Transom Frames: Fabricated from same material as adjacent door frame.
c. Construction: As directed Face or Full profile welded.

C. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.032 inch (0.8 mm), 0.042 inch (1.0 mm) or 0.053 inch (1.3 mm) as directed.

d. Edge Construction: As directed Continuously welded with no visible seam, Interlocking with visible seam, Interlocking with no visible seam or Projection, spot, or tack welded with or without visible seams.
e. Core: As directed Kraft-paper honeycomb, Polyisocyanurate, Polystyrene, Polyurethane or Vertical steel stiffener.
f. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.

2.6 EXTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES

A. Commercial Doors and Frames: NAAMM-HMMA 861; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.30 mm), with minimum G60 or A60 (ZF180) coating.
d. Edge Construction: Continuously welded with no visible seam.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Steel stiffened.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), except 0.067 inch (1.7 mm) for openings exceeding4 feet (1219 mm) wide; with minimum G60 or A60 (ZF180) coating.
b. Construction: As directed Face or Full profile welded.

B. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.

b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: As directed Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm) or 0.042 inch (1.0 mm), with minimum G60 or A60 (ZF180) coating.
d. Edge Construction: As directed Continuously welded with no visible seam, Interlocking with visible seam, Interlocking with no visible seam or Projection, spot, or tack welded with or without visible seams.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: as directed Kraft-paper honeycomb, Polyisocyanurate, Polystyrene, Polyurethane or Vertical steel stiffener.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum G60 or A60 (ZF180) coating.
b. Construction: as directed Knocked down, Face welded or Full profile welded.

2.7 BORROWED LITES

A. As directed Fabricate of uncoated or metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm) or 0.042 inch (1.0 mm).

B. Construction: As directed Knocked down, Face welded or Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.8 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.9 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.10 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled or square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.11 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with SDI A250.11 or NAAMM-HMMA 840 as directed.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated as directed.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: As directed Owner will engage or Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, section 5.2
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081119 - STAINLESS-STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless steel doors and frames.

1.2 COORDINATION

A. Coordinate anchorage installation for stainless steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

D. Samples:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).

E. Product Schedule: For stainless steel doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Product test reports.

C. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Temperature-Rise Limit: As directed Where indicated on Drawings or at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for some and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

C. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 STAINLESS STEEL DOORS AND FRAMES

A. Construct stainless steel door and frame assemblies to comply with NAAMM-HMMA 866 for the application indicated, including materials, fabrication methods, hardware reinforcement, tolerances, and clearances, and as specified. Comply with SDI A250.4, for Physical Performance Level A.

B. Doors and Frames for Moderately Corrosive Environments: At locations indicated in the Door and Frame Schedule.

1. Stainless Steel Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face Sheets: Type 304 stainless steel sheet, minimum thickness 0.050 inch (1.27 mm), 0.062 inch (1.59 mm) or 0.078 inch (1.98 mm) as directed.
d. Edge Construction: Continuously welded with no visible seam, Interlocking or lock tab visible seam or Intermittently welded visible seam as directed.
e. Top and Bottom Edges: Closed with continuous stainless steel channels with minimum thickness of 0.062 inch (1.27 mm), welded or adhesive laminated to face sheets as directed.

1) Provide flush top and bottom closures for exterior doors, with weep holes at bottom edge.

f. Core Construction: As directed Welded steel-stiffened core, Polyisocyanurate, polystyrene, or polyurethane laminated to face sheets or Steel-stiffener core laminated to face sheets.
g. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Stainless Steel Frames:

a. Materials: Type 304 stainless steel sheet.
b. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricate from stainless steel sheet, minimum thickness 0.062 inch (1.59 mm), 0.078 inch (1.98 mm), 0.109 inch (2.78 mm) as directed.
c. Door Frames for Openings More Than 48 Inches (1219 mm) Wide: Fabricate from stainless steel sheet, minimum thickness 0.078 inch (1.98 mm) or 0.109 inch (2.78 mm).
d. Construction: As directed Face welded, Full profile welded, Knocked down or Slip on.

3. Hardware Reinforcement: Stainless steel sheet.

4. Finish: as directed ASTM A480/A480M No. 4, Directional Satin, No. 6, Dull Satin, No. 8, Mirrorlike Reflective, Nondirectional Polish or No. 2B, Bright, Cold-Rolled, Unpolished.

C. Doors and Frames for Aesthetic Environments: At locations indicated in the Door and Frame Schedule.

1. Stainless Steel Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face Sheets: Type 304 stainless steel sheet, minimum thickness 0.050 inch (1.27 mm), 0.062 inch (1.59 mm) or 0.078 inch (1.98 mm) as directed.
d. Edge Construction: Continuously welded with no visible seam.
e. Top and Bottom Edges: Closed with continuous 0.062-inch- (1.59-mm-) thick stainless steel or 0.053-inch- (1.34-mm-) thick metallic-coated steel channels, welded or adhesive laminated to face sheets as directed.

1) Provide flush top and bottom closures for exterior doors, with weep holes at bottom edge.

f. Core Construction: Honeycomb kraft paper, Polyisocyanurate, polystyrene, or polyurethane or Steel-stiffener core laminated to face sheets as directed.
g. Fire-Rated Core: As directed Manufacturer's standard vertical steel stiffener or laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Stainless Steel Frames:

a. Materials: Type 304 stainless steel sheet.
b. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricate from stainless steel sheet, minimum thickness 0.062 inch (1.59 mm), 0.078 inch (1.98 mm) or 0.109 inch (2.78 mm) as directed.
c. Door Frames for Openings More Than 48 Inches (1219 mm) Wide: Fabricate from stainless steel sheet, minimum thickness 0.078 inch (1.98 mm) or 0.109 inch (2.78 mm) as directed.
d. Construction: As directed Face welded, Full profile welded, Knocked down or Slip on.

3. Hardware Reinforcement: Uncoated steel or Metallic-coated steel sheet as directed.
4. Finish: As directed ASTM A480/A480M No. 4, Directional Satin, No. 6, Dull Satin or No. 8, Mirrorlike Reflective, Nondirectional Polish.

2.4 MATERIALS

A. Stainless Steel Sheet: As directed ASTM A240/A240M, austenitic stainless steel, Type 304, Type 316 or Type 304 or 316 as indicated.

B. Steel Sheet: ASTM A1008/A1008M or ASTM A1011/A1011M, commercial steel, Type B.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, commercial steel, Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Foam-Plastic Insulation: As directed Manufacturer's standard polystyrene or urethane board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within door.

E. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.

F. Inserts, Bolts, and Anchor Fasteners: Stainless steel components complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2for bolts and nuts.

G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FRAME ANCHORS

A. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

B. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

C. Number and Spacing:

1. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c.
2. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.
3. Compression Type: Not less than two anchors in each jamb.
4. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

D. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

1. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

E. Material: Stainless steel sheet. Same type as door face.

F. Material: As directed Steel sheet or Metallic-coated steel sheet, hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 FABRICATION

A. Stainless Steel Door Fabrication: Provide doors rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 866.
2. Stops and Moldings: Factory cut openings in doors. Provide minimum 0.038-inch- (0.95-mm-) thick, stainless steel stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.

    a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
    b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

B. Stainless Steel Frame Fabrication: Provide stainless steel frames rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 866.
2. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
3. Borrowed-Lite Frames: As directed Fabricate from 0.062-inch- (1.59-mm-), 0.078-inch- (1.98-mm-) or 0.109-inch- (2.78-mm-) thick, stainless steel sheet.
4. Sidelite and Transom Frames: Fabricate from stainless steel sheet of same thickness as adjacent door frame.
5. As directed Mullions, Rails and Transom Bars: Provide closed tubular members with no visible face seams or joints. Fasten members at crossings and to jambs by butt welding according to joint designs in NAAMM-HMMA 820.
6. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
7. Door Silencers: Except on weather-stripped and gasketed frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

8. Stops and Moldings: Provide stops and moldings formed integrally with stainless steel frames around glazed lites and solid panels, minimum 5/8 inch (16 mm) high unless otherwise indicated. Form corners of stops and moldings with butted or mitered hairline joints.

    a. Loose Stops for Glazed Lites and Panels: 0.038-inch- (0.95-mm-) thick, stainless steel.
    b. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
    c. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each lite is capable of being removed independently.
    d. Coordinate rabbet width between fixed and removable stops with type of glazing or panel and type of installation.
    e. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

9. Terminated Stops: Where indicated on Drawings for interior door frames, terminate stops 6 inches (152 mm) above finish floor with a 45 or 90-degree angle cut as directed, and close open end of stop with stainless steel sheet closure. Cover opening in extension of frame with welded-stainless steel filler plate, with welds ground smooth and flush with frame.
10. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

C. Hardware Preparation: Factory prepare stainless steel doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule, and templates.

1. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 FINISHES

A. Stainless Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Grain Direction: For finishes exhibiting grain, run grain vertically on door faces and frame jambs.

2.8 ACCESSORIES

A. Glazing: Comply with requirements in Section 088000 "Glazing."

B. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.2 INSTALLATION

A. Stainless Steel Frames:

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    b. Install frames with removable glazing stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
6. Installation Tolerances: Adjust stainless steel frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Stainless Steel Doors: Fit and adjust stainless steel doors accurately in frames within clearances specified below:

1. Non-Fire-Rated Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA 866.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Install glazing in sidelites, transoms, and borrowed lites to comply with installation requirements in Section 088000 "Glazing."

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: As directed Owner will engage or Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING AND CLEANING

A. Stainless Steel Touchup: Immediately after erection, smooth any scratched or damaged areas of stainless steel; polish to match undamaged finish.

END OF SECTION 081119

SECTION 081173 - SLIDING METAL FIRE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-leaf, sliding fire door; manually operated.
2. Biparting, sliding fire door; manually operated.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
3. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Temperature-Rise Limit: Where indicated on Drawings, provide doors that have a maximum transmitted temperature end point of not more than indicated temperature above ambient after 30 minutes of standard fire-test exposure.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings or Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward as directed.
2. Testing: According to ASTM E330.

2.3 SLIDING METAL FIRE DOOR

A. Fire-Protection Rating: As directed 4 hours, 3 hours, 1-1/2 hours, 3/4 hour or As indicated.

1. Temperature-Rise Limit: As directed 250 deg F (139 deg C), 450 deg F (250 deg C) or 650 deg F (361 deg C).

B. Door Type: As directed Overhead supported from wall-mounted track or Bottom supported on floor track with top guide, with hidden reinforcements for mounting- and hardware-attachment locations, and with attached armor edges and astragals.

1. Configuration: As directed Single-leaf or Biparting.
2. Door Construction: Manufacturer's standard for opening size and required performance.

C. Operating System: Counterbalanced.

D. Facing Material:

1. Steel Sheet: 0.033-inch (0.8-mm) minimum thickness.
2. Metallic-Coated Steel Sheet: 0.040-inch (1.0-mm) nominal thickness.

E. Core Material: Provide manufacturer's standard core material according to fire-protection-rating and temperature-rise requirements.

F. Operating Hardware: Manufacturer's standard, labeled, automatic-closing-type, sliding fire door hardware complete with track, roller assemblies, adjustable roller guides, binders, floor stops, cables, counterbalance, and fusible links. Furnish necessary hangers, fittings, and fasteners required for attaching hardware to door and for door sliding operation, including latch or handle for manual operation.

G. Counterweight System: Cable-and-pulley system powered by weights that move within a formed-metal safety enclosure.

1. Safety Enclosure: Continuous, 0.064-inch- (1.6-mm-) thick, metallic-coated steel sheet; size as required for counterweights and clearance.

H. Crush Plates: Continuous 3/16-inch-thick by 6-inch-wide (4.8-mm-thick by 150-mm-wide) steel-bearing plates on hollow concrete masonry walls to bridge wall cavities and prevent through-wall bolts from crushing the masonry units.

I. Track Hood: Formed, metallic-coated steel sheet; shape and size as required for door clearance and to protect tracks; finished to match door.

J. Weather Stripping: Manufacturer's standard neoprene, vinyl, or nylon filament brush-style weather stripping around full door perimeter, with concealed attachments for mounting at head, jamb, and bottom edges of door, and acceptable to authorities having jurisdiction.

K. Interconnecting Device: Device that connects fusible links for doors on both sides of wall.

L. Door-Release Device: Electromagnetic release device compatible with smoke detectors and building's fire-alarm system.

M. Smoke Detectors: Early warning, photoelectric smoke detectors or ionization detectors coupled to electromagnetic door-release device and building's fire-alarm system.

N. Vision Panels: Factory fabricated in door with removable glass stops. Provide glazing product listed and labeled as a component for fire-protection-rated sliding fire door assembly by a qualified testing agency acceptable to authorities having jurisdiction; do not exceed area allowed for door's fire-protection rating.

2.4 MATERIALS

A. Steel Plate, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheets: ASTM A1008/A1008M, cold rolled or ASTM A1011/A1011M, hot rolled Commercial Steel (CS) or Drawing Steel (DS).

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), with G60 (Z180)or G90 (Z275) zinc coating or A60 (ZF180) zinc-iron-alloy (galvannealed) coating; restricted flatness.

D. Hardware and Fastener Finish: As directed Manufacturer's standard, Hot-dip galvanize according to ASTM A153/A153M where units are used on galvanized-steel exterior doors or Stainless steel.

2.5 FABRICATION

A. Factory prepare sliding metal fire door assemblies and frames to receive hardware and accessories including cutouts, reinforcements, mortising, drilling, and tapping.

2.6 METALLIC-COATED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range as directed.

2.7 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" or SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning". After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range as directed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sliding metal fire doors according to NFPA 80 and manufacturer's written instructions for type of door operation indicated and fire-protection rating required.

1. Connect fire-detection devices with building's fire-alarm system.

B. Concrete Masonry: Install continuous crush plates between concrete masonry walls and tracks and operating mechanisms mounted to the walls.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform acceptance testing according to NFPA 80.

a. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

2. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

1. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 DEMONSTRATION

A. As directed Engage a factory-authorized service representative to train or Train Owner's maintenance personnel to adjust, operate, and maintain sliding metal fire doors.

END OF SECTION 081173

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.
2. Interior custom hollow-metal frames.
3. Borrowed lites.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.

D. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 STANDARD STEEL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Interior Frames: SDI A250.8. At locations indicated in the Door and Frame Schedule.

1. Materials: Uncoated or Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), 0.053 inch (1.3 mm) or 0.067 inch (1.7 mm) as directed.
2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.
4. Exposed Finish: As directed Prime or Factory.

2.4 CUSTOM HOLLOW-METAL FRAMES

A. Interior Frames: NAAMM-HMMA 861. At locations indicated in the Door and Frame Schedule.

1. Materials: As directed Uncoated or Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: As directed Knocked down, Slip-on drywall, Face welded or Full profile welded.
4. Exposed Finish: Prime.

2.5 BORROWED LITES

A. As directed Fabricate of uncoated or metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm) or 0.042 inch (1.0 mm).

B. Construction: As directed Knocked down, Face welded or Full profile welded.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Post Installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials.

F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: SDI A250.10.

B. Factory Finish: SDI A250.3.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 or NAAMM-HMMA 840 as directed.

B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
2. Install frames with removable stops located on secure side of opening.

C. Fire-Rated Openings: Install frames according to NFPA 80.

D. Floor Anchors: Secure with post installed expansion anchors.

1. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.

E. Solidly pack mineral-fiber insulation inside frames.

F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

G. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

I. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.2 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum frames for doors installed in gypsum board partitions.
2. Interior aluminum frames for glazing installed in gypsum board partitions.
3. Interior aluminum doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For aluminum frames:

1. Include elevations, sections, and installation details for each wall-opening condition.

D. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Frames: Frames for fire-rated door assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Frames for Smoke- and Draft-Control Assemblies: Tested according to UL 1784 and installed in compliance with NFPA 105.

a. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (0.9 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa).

2.3 COMPONENTS

A. Aluminum Framing: ASTM B221 (ASTM B221M), with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch (1.6 mm) thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Glazing Frames: Extruded aluminum, for indicated glass thickness.

D. Door Tracks: Extruded aluminum where exposed, sized to enclose sliding-door hardware, and in finish matching frame and trim finish.

E. Trim: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick; removable, snap-in casing trim, glazing stops and door stops, without exposed fasteners.

1. Trim Style: As directed.

F. Doors: As specified in Section 081416 "Flush Wood Doors." Section 083213 "Sliding Aluminum-Framed Glass Doors." Section 084113 "Aluminum-Framed Entrances and Storefronts." Section 084213 "Aluminum-Framed Entrances."

G. Doors: Manufacturer's standard, factory-assembled, 1-3/4-inch- (45-mm-) thick, aluminum-framed door construction.

1. Door Operation: As directed Pocket, Sliding or Swinging.
2. Stiles: As directed Narrow, Medium, Wide or 3-3/4 inches (95 mm).
3. Rails: As directed 3-3/4-inch (95-mm) or 6-inch (152-mm) top rail and 6-inch (152-mm) or 9-1/2-inch (241-mm) bottom rail.

H. Door Finish: As directed Match frame and trim finish, Clear-anodized aluminum, Color-anodized aluminum, Factory-applied, baked-enamel or powder-coat finish or High-performance organic finish.

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range, Light bronze, Medium bronze, Dark bronze or Black.

I. Frame and Trim Finish: Clear-anodized aluminum, Color-anodized aluminum, Factory-applied, baked-enamel or powder-coat finish or High-performance organic finish as directed.

1. Color: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range, Light bronze, Medium bronze, Dark bronze or Black.

2.4 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals in black color.

C. Smoke Seals: Intumescent strip or fire-rated gaskets in black.

D. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in black.

E. Glass: As specified in Section 088000 "Glazing." Section 088113 "Decorative Glass Glazing." Section 088400 "Plastic Glazing."

F. Door Hardware: As selected by Architect from manufacturer's full range. As specified in Section 087100 "Door Hardware." As specified in Section 087111 "Door Hardware (Descriptive Specification)."

2.5 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.

B. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification).

1. Locate hardware cutouts and reinforcements as required by fire-rated label for assembly.

C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.

1. Locate removable stops on the inside of spaces accessed by keyed doors.

D. Fabricate components to allow secure installation without exposed fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.

1. At fire-protection-rated openings, install fire-rated frames according to NFPA 80 and NFPA 105.

B. Install frame components in the longest possible lengths with no piece less than 48 inches (1220 mm); components 72 inches (1830 mm) or 96 inches (2450 mm) or shorter shall be one piece as directed.

C. Glass: Install glass according to Section 088000 "Glazing" and Section 088113 "Decorative Glass Glazing" and Section 088400 "Plastic Glazing" and aluminum-frame manufacturer's written instructions.

D. Doors: Install doors aligned with frames and fitted with required hardware.

E. Door Hardware: Install according to Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" and aluminum-frame manufacturer's written instructions.

3.2 ADJUSTING

A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 and 610.

B. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches (1220 mm) as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 081316.13 - ALUMINUM TERRACE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum terrace doors for exterior locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of aluminum terrace door.

B. Shop Drawings: For aluminum terrace doors.

C. Samples: For each aluminum terrace door and for each color and texture specified, 12-inch-long (300-mm-long) section with weather stripping, glazing bead and factory-applied color finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum terrace doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of aluminum terrace doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Aluminum Terrace Door: As directed Three or Five years from date of Substantial Completion.

b. Insulating-Glass Units: As directed 10 or 20 years from date of Substantial Completion.
c. Laminated Glass: Five years from date of Substantial Completion.
d. Aluminum Finish: As directed Five, 10 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AMMA certified with label attached to each door.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: Class R, Class LC, Class CW, Class AW or As indicated on Drawings.
2. Minimum Performance Grade: As directed Grade 35, Grade 40, Grade 45, Grade 50, Grade 60, Grade 70 or As indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K) as directed.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.30 or 0.27 as directed.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection as directed.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m)and 60 feet (18.3 m) above grade.

2.3 ALUMINUM TERRACE DOORS

A. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.

B. Threshold: Provide extruded-aluminum threshold of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior; with manufacturer's standard finish.

1. Low-Profile Threshold: ADA-ABA compliant.

2.4 GLAZING

A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements for windborne-debris resistance. Comply with requirements indicated in Section 088000 "Glazing."

1. Glass: ASTM C1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
2. Safety Glazing Labeling: Permanently mark safety glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
3. Insulating-Glass Units: ASTM E2190, certified through IGCC as complying with requirements of IGCC.

a. Filling: Fill space between glass lites with air or argon as directed.
b. Low-E coating.

2.5 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock aluminum terrace doors.

B. Lock: Install manufacturer's standard keyed multipoint locking device on each operable panel, lockable from the inside only and outside.

2.6 ACCESSORIES

A. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for aluminum terrace doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.7 FABRICATION

A. Fabricate aluminum terrace doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Weather Stripping: Provide full-perimeter weather stripping for each door panel.

C. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.

D. Factory-Glazed Fabrication: Glaze aluminum terrace doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As directed Light bronze, Medium bronze, Dark bronze or Black.
2. Color: Match Architect's sample or As selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: As directed Three-coat or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.

B. Windborne Debris Resistance: Anchor aluminum terrace doors that have been tested for windborne debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne debris resistance testing.

C. Install aluminum terrace doors level, plumb, square, true to line; without distortion, warp, or rack of frames and panels and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.

D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

E. Install aluminum terrace doors and components to drain condensation, water-penetrating joints, and moisture migrating within doors to the exterior.

F. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

G. Adjust operating panels to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

END OF SECTION 081316.13

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Five-ply flush wood doors for opaque finish.
3. Solid-core flush wood doors with plastic-laminate-faces.
4. Hollow-core flush wood veneer-faced doors for transparent finish.
5. Hollow-core flush wood doors for opaque finish.
6. Hollow-core flush wood doors with plastic-laminate faces.
7. Fire-rated wood door frames.
8. Factory priming or finishing flush wood doors and frames.
9. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory-priming or finishing specifications.

B. Sustainable Design Submittals:

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.

8. As directed Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings.

D. Samples: For plastic-laminate door faces, polymer edging, factory-finished doors and factory-finished door frames as directed.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification or WI Certified Compliance Program certificates as directed.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program or WI's Certified Compliance Program as directed.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: As directed Where indicated on Drawings or At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with "Architectural Woodwork Standards." WDMA I.S. 1A.

1. Provide labels and certificates from AWI or WI certification program indicating that doors and frames comply with requirements of grades specified as directed.

    a. This project has been registered with AWI as AWI Quality Certification Program Number as directed.
    b. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.

2.3 FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Exterior Doors:
1. Performance Grade: WDMA I.S. 1A Extra Heavy Duty, Heavy Duty or as indicated on Drawings.
2. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed.
3. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

    a. Species: As directed Anigre, Select white ash, Figured select white ash, Select white birch, Select red birch, Cherry, Select red gum, Figured select red gum, Select white maple, Red oak, White oak, Persimmon, Sapele, Sycamore or Walnut.
    b. Cut: As directed Rotary cut, Plain sliced (flat sliced), Quarter sliced or Rift cut.

c. Match between Veneer Leaves: As directed Book, Slip or Random match.
d. Assembly of Veneer Leaves on Door Faces: As directed Center-balance, Balance or Running match.
e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

4. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A, Same species as faces - Architectural Woodwork Standards edge Type A, Applied wood-veneer edges of same species as faces and covering edges of faces - Architectural Woodwork Standards edge Type B or Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D as directed.
5. Core: As directed ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard.
6. Core: Glued wood stave.
7. Core: WDMA I.S. 10 structural composite lumber.

a. Screw Withdrawal, Face: 700 lbf (3100 N).
b. Screw Withdrawal, Edge: 400 lbf (1780 N).

8. Core: Either glued wood stave or WDMA I.S. 10 structural composite lumber.
9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
10. Adhesives: Type I in accordance with WDMA T.M. 6.

B. Interior Doors:
1. Performance Grade: WDMA I.S. 1A Extra Heavy Duty, Heavy Duty, Standard Duty or as indicated on Drawings.
2. Performance Grade:

a. WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
b. WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, exits and patient rooms and where indicated on Drawings.
c. WDMA I.S. 1A Standard Duty: As directed Closets (not including janitor's closets) and private toilets and where indicated on Drawings.

3. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed .
4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

a. Species: As directed Anigre, Select white ash, Figured select white ash, Select white birch, Select red birch, Cherry, Select red gum, Figured select red gum, Select white maple, Red oak, White oak, Persimmon, Sapele, Sycamore or Walnut.
b. Cut: As directed Rotary cut, Plain sliced (flat sliced), Quarter sliced or Rift cut.
c. Match between Veneer Leaves: As directed Book, Slip or Random match.
d. Assembly of Veneer Leaves on Door Faces: As directed Center-balance, Balance or Running match.
e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

f. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or 20 feet (6 m) or more.
g. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
h. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."

5. Exposed Vertical and Top Edges: As directed Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A, Same species as faces - Architectural Woodwork Standards edge Type A, Applied wood-veneer edges of same species as faces and covering edges of faces - Architectural Woodwork Standards edge Type B or Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D.

a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
c. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

1) Finish steel edges and astragals with baked enamel same color as doors.
2) Finish steel edges and astragals to match door hardware (locksets or exit devices).

d. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors: As directed ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard.

a. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware. follows:

1) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
2) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

b. Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit

devices in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification."

7. Core for Non-Fire-Rated Doors: Glued wood stave.
8. Core for Non-Fire-Rated Doors: WDMA I.S. 10 structural composite lumber.

    a. Screw Withdrawal, Face: 700 lbf (3100 N).
    b. Screw Withdrawal, Edge: 400 lbf (1780 N).

9. Core for Non-Fire-Rated Doors: Either glued wood stave or WDMA I.S. 10 structural composite lumber.
10. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

    a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware. follows:

        1) 5-inch (125-mm) top-rail blocking.
        2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
        3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
        4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks or 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices as directed.

11. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Exterior Doors:
1. Performance Grade: WDMA I.S. 1A Extra Heavy Duty, Heavy Duty or as indicated on Drawings.
2. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed.
3. Faces: MDO or Any closed-grain hardwood of mill option as directed.

    a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.

4. Exposed Vertical and Top Edges: Any closed-grain hardwood.
5. Core: ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard.
6. Core: Glued wood stave.
7. Core: WDMA I.S. 10 structural composite lumber.

    a. Screw Withdrawal, Face: 700 lbf (3100 N).
    b. Screw Withdrawal, Edge: 400 lbf (1780 N).

8. Core: Either glued wood stave or WDMA I.S. 10 structural composite lumber.

9. Construction: Five plies, hot-pressed, bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
10. Adhesives: Type I in accordance with WDMA T.M. 6.

B. Interior Solid-Core Doors:
1. Performance Grade: WDMA I.S. 1A Extra Heavy Duty, Heavy Duty, Standard Duty or as indicated on Drawings.
2. Performance Grade:

    a. WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
    b. WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, exits and patient rooms and where indicated on Drawings.
    c. WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets) and private toilets and where indicated on Drawings.

3. Architectural Woodwork Standards WDMA I.S. 1A Grade: As directed Premium or Custom.
4. Faces: MDO, Any closed-grain hardwood of mill option or Hardboard or MDF.

    a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
    b. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
    c. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.

5. Exposed Vertical and Top Edges: Any closed-grain hardwood.

    a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
    b. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    c. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

        1) Finish steel edges and astragals with baked enamel same color as doors.
        2) Finish steel edges and astragals to match door hardware (locksets or exit devices).

    d. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors: As directed ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard.

a. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware. follows:

1) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
2) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

b. As directed Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification."

7. Core for Non-Fire-Rated Doors: Glued wood stave.
8. Core for Non-Fire-Rated Doors: WDMA I.S. 10 structural composite lumber.

a. Screw Withdrawal, Face: 700 lbf (3100 N).
b. Screw Withdrawal, Edge: 400 lbf (1780 N).

9. Core for Non-Fire-Rated Doors: Either glued wood stave or WDMA I.S. 10 structural composite lumber.
10. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware. follows:

1) 5-inch (125-mm) top-rail blocking.
2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks or 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

11. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 SOLID-CORE FLUSH WOOD DOORS WITH PLASTIC-LAMINATE FACES

A. Interior Doors:
1. Performance Grade: WDMA I.S. 1A Extra Heavy Duty, Heavy Duty, Standard Duty or as indicated on Drawings.
2. Performance Grade:

a. WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
b. WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, exits and patient rooms and where indicated on Drawings.
c. WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets) and private toilets and where indicated on Drawings.

3. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed.
4. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS or Grade HSH as directed.
5. Colors, Patterns, and Finishes: As indicated, As selected by Architect from laminate manufacturer's full range of products.
6. Exposed Vertical and Top Edges: Hardwood edges for staining to match faces, Hardwood edges for painting, Plastic laminate that matches faces, applied before faces or impact-resistant polymer edging, applied after faces as directed.

    a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
    b. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    c. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

        1) Finish steel edges and astragals with baked enamel same color as doors.
        2) Finish steel edges and astragals to match door hardware (locksets or exit devices).

    d. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) in accordance with WDMA T.M. 10.

7. Core for Non-Fire-Rated Doors: ANSI A208.1, Grade LD-1 or Grade LD-2 particleboard as directed .

    a. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware. follows:

        1) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
        2) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
        3) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

    b. Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification."

8. Core for Non-Fire-Rated Doors: Glued wood stave.
9. Core for Non-Fire-Rated Doors: WDMA I.S. 10 structural composite lumber.

    a. Screw Withdrawal, Face: 700 lbf (3100 N).

b. Screw Withdrawal, Edge: 400 lbf (1780 N).

10. Core for Non-Fire-Rated Doors: Either glued wood stave or WDMA I.S. 10 structural composite lumber.
11. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

    a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware. follows:

        1) 5-inch (125-mm) top-rail blocking.
        2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
        3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
        4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks or 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices as directed.

12. Construction: Three plies, hot-pressed or cold-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before faces are applied.
13. Construction: Five plies, hot-pressed or cold-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before faces and crossbands are applied.

2.6 HOLLOW-CORE FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:
1. Performance Grade: WDMA I.S. 1A Standard Duty.
2. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed.
3. Species: Anigre, Select white ash, Figured select white ash, Select white birch, Select red birch, Cherry, Select red gum, Figured select red gum, Select white maple, Red oak, White oak, Persimmon, Sapele, Sycamore or Walnut.
4. Cut: As directed Rotary cut, Plain sliced (flat sliced), Quarter sliced or Rift cut.
5. Match between Veneer Leaves: As directed Book, Slip or Random match.
6. Assembly of Veneer Leaves on Door Faces: As directed Center-balance, Balance or Running match.
7. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
8. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A, Same species as faces - Architectural Woodwork Standards edge Type A, Applied wood-veneer edges of same species as faces and covering edges of faces - Architectural Woodwork Standards edge Type B or Applied wood edges of same species as faces and covering edges of crossbands - Architectural Woodwork Standards edge Type D.
9. Construction: As directed Institutional or Standard hollow core.
10. Blocking: Provide wood blocking with minimum dimensions as follows:

    a. 5-by-18-inch (125-by-460-mm) lock blocks at both stiles.

b. 5-inch (125-mm) top- and bottom-rail blocking.
c. 10-inch (250-mm) top- and bottom-rail blocking.
d. 2-1/2-inch (64-mm) midrail blocking.

2.7 HOLLOW-CORE FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Doors:
1. Performance Grade: WDMA I.S. 1A Standard Duty.
2. Architectural Woodwork Standards WDMA I.S. 1A Grade: As directed Premium or Custom.
3. Faces: As directed Any closed-grain hardwood of mill option or Hardboard or MDF.

a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.

4. Exposed Vertical and Top Edges: Any closed-grain hardwood.
5. Construction: As directed Institutional or Standard hollow core.
6. Blocking: Provide wood blocking with minimum dimensions as follows:

a. 5-by-18-inch (125-by-460-mm) lock blocks at both stiles.
b. 5-inch (125-mm) top- and bottom-rail blocking.
c. 10-inch (250-mm) top- and bottom-rail blocking.
d. 2-1/2-inch (64-mm) midrail blocking.

2.8 HOLLOW-CORE FLUSH WOOD DOORS WITH PLASTIC-LAMINATE FACES

A. Interior Doors:
1. Performance Grade: WDMA I.S. 1A Standard Duty.
2. Architectural Woodwork Standards WDMA I.S. 1A Grade: As directed Premium or Custom.
3. Plastic-Laminate Faces: As directed High-pressure decorative laminates complying with NEMA LD 3, Grade HGS or Grade HSH.
4. Colors, Patterns, and Finishes: As indicated As selected by Architect from laminate manufacturer's full range of products.
5. Exposed Vertical and Top Edges: As directed Hardwood edges for staining to match faces, Hardwood edges for painting, Plastic laminate that matches faces, applied before faces or Impact-resistant polymer edging, applied after faces.

a. Polymer Edging Color: As directed Beige, Brown or Same color as faces.

6. Construction: Institutional or Standard hollow core as directed.
7. Blocking: Provide wood blocking with minimum dimensions as follows:

a. 5-by-18-inch (125-by-460-mm) lock blocks at both stiles.
b. 5-inch (125-mm) top- and bottom-rail blocking.
c. 10-inch (250-mm) top- and bottom-rail blocking.
d. 2-1/2-inch (64-mm) midrail blocking.

2.9 FIRE-RATED WOOD DOOR FRAMES

A. Interior Frames:
   1. Architectural Woodwork Standards WDMA I.S. 1A Grade: As directed Premium or Custom.
   2. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
   3. Species: As directed Anigre, Select white ash, Figured select white ash, Select white birch, Select red birch, Cherry, Select red gum, Figured select red gum, Select white maple, Red oak, White oak, Persimmon, Sapele, Sycamore or Walnut.
   4. Cut: As directed Plain sliced/plain sawn, Quarter cut/quarter sawn or Rift cut/rift sawn.
   5. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.
   6. Profile: As directed T-stop, Flat, Single rabbet, Double rabbet or As indicated on Drawings.
   7. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

2.10 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

   1. Wood Species: As directed Same species as door faces, Species compatible with door faces or Any closed-grain hardwood.
   2. Profile: As directed Flush rectangular beads, Recessed tapered beads, Recessed tapered beads with exposed banding, Lipped tapered beads or Manufacturer's standard shape.
   3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; factory primed for paint with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

D. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

   1. Wood Species: As directed Same species as door faces, Species compatible with door faces or Any closed-grain hardwood.
   2. Profile: As directed Flat or Chevron.

E. Metal Louvers:
   1. Blade Type: As directed Vision-proof, inverted V, Vision-proof, inverted Y or Darkroom-type, double inverted V.

2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint or with baked-enamel- or powder-coated finish as directed.
3. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.
4. Metal and Finish: As directed Extruded aluminum with light bronze, medium bronze, dark bronze or black, Class II, color anodic finish, AA-M12C22A32/A34.

F. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
1. Metal and Finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint or with baked-enamel- or powder-coated finish.

2.11 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

D. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory priming or finishing as directed.

1. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.12 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting." Section 099123" Interior Painting."

2.13 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Factory finish doors that are indicated on Drawings to receive transparent finish.

D. Factory finish doors where indicated in schedules or on Drawings as factory finished.

E. Transparent Finish:

1. Architectural Woodwork Standards WDMA I.S. 1A Grade: As directed Premium or Custom.
2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
3. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
4. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
5. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
6. Finish: WDMA I.S. 1A TR-4 Conversion Varnish.
7. Finish: WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
8. Finish: WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
9. Staining: As directed Match Architect's sample, As selected by Architect from manufacturer's full range or None required.
10. Effect: As directed Open-grain finish, Filled finish or Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores as directed.
11. Sheen: As directed Satin or Semigloss.

F. Opaque Finish:

1. Architectural Woodwork Standards WDMA I.S. 1A Grade: Premium or Custom as directed.
2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
3. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
4. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
5. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
6. Finish: WDMA I.S. 1A OP-4 Conversion Varnish.

7. Finish: WDMA I.S. 1A OP-6 Catalyzed Polyurethane.
8. Color: As directed Match Architect's sample or As selected by Architect from manufacturer's full range.
9. Sheen: As directed Satin, Semigloss or Gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware.", Section 087111 "Door Hardware (Descriptive Specification)."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
        1) For factory-finished items, use filler matching finish of items being installed.
3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:
    a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.
5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage or Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Provide inspection of installed Work through AWI's Quality Certification Program WI's Certified Compliance Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101 as directed.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior stile and rail wood doors.
2. Interior stile and rail wood doors.
3. Interior fire-rated stile and rail wood doors.
4. Fire-rated wood door frames.
5. Factory fitting stile and rail wood doors to frames and factory machining for hardware.
6. Factory priming or finishing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Details of construction and glazing.
2. Door frame construction.
3. Factory-machining criteria.
4. Factory-priming or finishing specifications.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Clearances and undercuts.
6. Requirements for veneer matching.
7. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings as directed.

D. Samples: For factory-finished doors and factory-finished door frames.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification or WI Certified Compliance Program certificates as directed.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program or WI's Certified Compliance Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Door Thermal Transmittance: Maximum whole fenestration product U-factor of 0.25 (1.41), 0.30 (1.70), 0.35 (1.98), 0.40 (2.27), 0.45 (2.55) or 0.65 (3.69) according to AAMA 1503, ASTM E1423, or NFRC 100 as directed.

B. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to UL 10Ca or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: As directed Where indicated on Drawings or At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.2 MATERIALS

A. Use only materials that comply with referenced standards and other requirements specified.

1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.
2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.

B. Panel Products: Any of the following unless otherwise indicated:

1. Particleboard: ANSI A208.1, Grade M-2.
2. Medium-density fiberboard (MDF,) complying with ANSI A208.2, Grade 130.
3. Hardboard complying with ANSI A135.4.
4. Veneer-core plywood.

C. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.3 EXTERIOR STILE AND RAIL WOOD DOORS

A. Exterior Stile and Rail Wood Doors: Exterior stock or custom doors complying with the AWI, AWMAC, and WI's Architectural Woodwork Standards, or WDMA I.S. 6A, and with other requirements specified.
1. Performance Grade: WDMA I.S. 6A Extra Heavy Duty, Heavy Duty or As indicated on Drawings.
2. Architectural Woodwork Standards WDMA I.S. 6A Grade: Custom
3. Panel Designs: As indicated on Drawings.

    a. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.
    b. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

4. Finish: Transparent or Opaque.

5. Wood Species and Cut for Transparent Finish: As directed Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced, Douglas fir or western hemlock, quarter sawed/sliced (vertical grain), Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels or Species indicated on Drawings, plain sawed/sliced.
6. Door Construction for Transparent Finish:

    a. Stile and Rail Construction: Clear lumber; may be edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    b. Stile and Rail Construction: Veneered, structural composite lumber or veneered, edge- and end-glued clear lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch (1.6 mm) thick.
    c. Raised-Panel Construction: Clear lumber; edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    d. Raised-Panel Construction: Edge-glued, clear lumber; glued to both sides of a wood-based panel product. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    e. Raised-Panel Construction: Veneered, wood-based panel product with mitered, raised rims made from matching clear lumber.
    f. Raised-Panel Construction: Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.

7. Door Construction for Opaque Finish:

    a. Stile and Rail Construction: Clear softwood; may be edge glued for width and finger jointed.
    b. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.
    c. Raised-Panel Construction: Clear softwood lumber; edge glued for width.
    d. Raised-Panel Construction: Veneered, wood-based panel product.

8. Stile and Rail Widths: As indicated on Drawings. Manufacturer's standard, but not less than the following:

    a. Stiles, Top and Intermediate Rails: 5-3/8 inches (137 mm).
    b. Bottom Rails: 11-3/8 inches (289 mm).

9. Raised-Panel Thickness: As indicated on Drawings, 1-3/4 inches (44 mm), 1-3/8 inches (35 mm) or Manufacturer's standard, but not less than 1-1/8 inches (29 mm).
10. Molding Profile (Sticking): As directed Bead and cove, Ogee, Ovalo, Recessed bevel, Recessed square, Manufacturer's standard or As selected by Architect from manufacturer's full range.
11. Glass: Uncoated, clear, fully tempered float glass, 5.0 mm thick, laminated glass made from two lites of 3.0-mm-thick annealed glass, insulating-glass units made from two lites of 3.0-mm-thick, fully tempered glass with 1/4-inch (6.4-mm) interspace, complying with Section 088000 "Glazing" as directed.
12. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.4 INTERIOR STILE AND RAIL WOOD DOORS

A. Interior Stile and Rail Wood Doors: Interior stock or custom doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards or WDMA I.S. 6A and with other requirements specified.

1. Performance Grade: WDMA I.S. 6A Extra Heavy Duty, Heavy Duty, Standard Duty or As indicated on Drawings.
2. Architectural Woodwork Standards, WDMA I.S. 6A Grade: Custom.
3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Transparent or Opaque as directed.
5. Wood Species and Cut for Transparent Finish: As directed Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced, Douglas fir or western hemlock, quarter sawed/sliced (vertical grain), Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels or Species indicated on Drawings, plain sawed/sliced.
6. Door Construction for Transparent Finish:

    a. Stile and Rail Construction: Clear lumber; may be edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    b. Stile and Rail Construction: Veneered, structural composite lumber or veneered, edge- and end-glued clear lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch (1.6 mm) thick.
    c. Raised-Panel Construction: Clear lumber; edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    d. Raised-Panel Construction: Edge-glued, clear lumber; glued to both sides of a wood-based panel product. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    e. Raised-Panel Construction: Veneered, wood-based panel product with mitered, raised rims made from matching clear lumber.
    f. Raised-Panel Construction: Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.
    g. Flat-Panel Construction: Veneered, wood-based panel product.

7. Door Construction for Opaque Finish:

    a. Stile and Rail Construction: Clear softwood; may be edge glued for width and finger jointed.
    b. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.
    c. Raised-Panel Construction: Clear softwood lumber; edge glued for width.
    d. Raised-Panel Construction: Shaped, medium-density fiberboard.
    e. Flat-Panel Construction: As directed Veneered, wood-based panel product or Medium-density fiberboard.

8. Stile and Rail Widths: As indicated. Manufacturer's standard, but not less than the following:

a. Stiles, Top and Intermediate Rails: 4-1/2 inches (114 mm).
b. Bottom Rails: 9 inches (229 mm).

9. Raised-Panel Thickness: As indicated or 1-3/4 inches (44 mm), 1-3/8 inches (35 mm), Manufacturer's standard, but not less than 1-1/8 inches (29 mm), Manufacturer's standard, but not less than 3/4 inch (19 mm).
10. Flat-Panel Thickness: As indicated 1/2 inch (13 mm), 3/8 inch (10 mm) or 1/4 inch (6.4 mm).
11. Molding Profile (Sticking): Bead and cove, Ogee, Ovalo, Recessed bevel, Recessed square, Manufacturer's standard or As selected by Architect from manufacturer's full range.
12. Glass: Uncoated, clear, fully tempered float glass, 5.0 mm thick or laminated glass made from two lites of 3.0-mm-thick annealed glass, complying with Section 088000 "Glazing."
13. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.5 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

A. Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (20-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards or WDMA I.S. 6A and with other requirements specified.
1. Performance Grade: As directed WDMA I.S. 6A Extra Heavy Duty, Heavy Duty, Standard Duty or As indicated on Drawings.
2. Architectural Woodwork Standards WDMA I.S. 6A Grade: Custom.
3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Transparent or Opaque as directed.
5. Wood Species and Cut for Transparent Finish: As directed Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced, Douglas fir or western hemlock, quarter sawed/sliced (vertical grain), Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels or Species indicated on Drawings, plain sawed/sliced.
6. Door Construction for Transparent Finish: 1-3/4-inch- (44-mm-) thick stiles and rails and veneered flat panels not less than 5/8 inch (16 mm) thick or raised panels not less than 1-1/8 inches (29 mm) thick as directed.

a. Stile and Rail Construction: Veneered, structural composite lumber or veneered, edge- and end-glued clear lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch (1.6 mm) thick.
b. Raised-Panel Construction: Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.
c. Flat-Panel Construction: Veneered, wood-based panel product.
d. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
e. Edge Construction for Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and

astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

f. Edge Construction for Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

1) Finish steel edges and astragals with baked enamel same color as doors.
2) Finish steel edges and astragals to match door hardware (locksets or exit devices).

7. Door Construction for Opaque Finish: 1-3/4-inch- (44-mm-) thick stiles and rails and veneered flat panels not less than 5/8 inch (16 mm) thick or raised panels not less than 1-1/8 inches (29 mm) thick as directed.

a. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.
b. Raised-Panel Construction: Shaped medium-density fiberboard (MDF.)
c. Flat-Panel Construction: Veneered, wood-based panel product, Medium-density fiberboard (MDF) as directed.
d. Edge Construction for Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
e. Edge Construction for Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
f. Edge Construction for Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

1) Finish steel edges and astragals with baked enamel same color as doors.
2) Finish steel edges and astragals to match door hardware (locksets or exit devices).

8. Stile and Rail Widths: As indicated on Drawings. Manufacturer's standard, but not less than the following:

a. Stiles, Top and Intermediate Rails: 4-1/2 inches (114 mm).
b. Bottom Rails: 9 inches (229 mm).

9. Molding Profile (Sticking): As directed Bead and cove, Ogee, Ovalo, Recessed bevel, Recessed square, Manufacturer's standard or As selected by Architect from manufacturer's full range.
10. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

B. Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (45-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.
1. Performance Grade: WDMA I.S. 6A Extra Heavy Duty, Heavy Duty, Standard Duty or As indicated on Drawings.
2. Architectural Woodwork Standards WDMA I.S. 6A Grade: Custom.

3. Panel Designs: Indicate on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
4. Finish: Transparent or Opaque as directed.
5. Wood Species and Cut for Transparent Finish: As directed Idaho white, lodgepole, ponderosa, or sugar pine, plain sawed/sliced, Douglas fir or western hemlock, quarter sawed/sliced (vertical grain), Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels or Species indicated on Drawings, plain sawed/sliced.
6. Interior Fire-Rated Door Construction: 1-3/4-inch- (44-mm-) thick, edged and veneered mineral-core stiles and rails and 1-1/8-inch- (29-mm-) thick, veneered mineral-core raised panels.
7. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

    a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) according to WDMA T.M. 10.

8. Edge Construction for Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

    a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) according to WDMA T.M. 10 as directed.

9. Edge Construction for Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.

    a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: As directed 550 lbf (2440 N), 475 lbf (2110 N) or 400 lbf (1780 N) according to WDMA T.M. 10.

    b. Finish steel edges and astragals with baked enamel same color as doors.
    c. Finish steel edges and astragals to match door hardware (locksets or exit devices).

10. Stile and Rail Widths: As indicated. Manufacturer's standard, but not less than the following:

a. Stiles, Top and Intermediate Rails: 4-1/2 inches (114 mm).
b. Bottom Rails: 9 inches (229 mm).

11. Molding Profile (Sticking): As directed Bead and cove, Ogee, Ovalo, Recessed bevel, Recessed square, Manufacturer's standard or As selected by Architect from manufacturer's full range.

2.6 FIRE-RATED WOOD DOOR FRAMES

A. Interior Frames:
1. Architectural Woodwork Standards WDMA I.S. 6A Grade: As directed Premium or Custom.
2. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
3. Species: As directed Anigre, Select white ash, Figured select white ash, Select white birch, Select red birch, Cherry, Select red gum, Figured select red gum, Select white maple, Red oak, White oak, Persimmon, Sapele, Sycamore or Walnut.
4. Cut: Plain sliced/plain sawn, Quarter cut/quarter sawn or Rift cut/rift sawn as directed.
5. Wood Moisture Content: As directed 5 to 10, 8 to 13 or 4 to 9 percent.
6. Profile: T-stop, Flat, Single rabbet, Double rabbet or As indicated on Drawings.
7. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

2.7 STILE AND RAIL WOOD DOOR FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

1. Clearances:

a. Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors.
b. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering.
c. Where threshold is shown on Drawings or scheduled, provide not more than 3/8 inch (10 mm) from bottom of door to top of threshold.
d. Comply with NFPA 80 requirements for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

B. Fabricate stile and rail wood doors in sizes indicated for field fitting.

C. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.

2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings: Trim openings indicated for glazing with solid-wood moldings, with one side removable. Miter wood moldings at corner joints.

E. Glazed Openings: Factory install glazing in doors, complying with Section 088000 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

F. Exterior Doors: Factory treat exterior doors with water-repellent preservative after fabrication has been completed but before shop priming or factory finishing as directed.

1. Comply with WDMA I.S. 4.
2. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.8 FACTORY PRIMING

A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

2.9 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Factory finish doors that are indicated to receive transparent finish.

D. Factory finish doors where indicated in schedules or on Drawings.

E. Transparent Finish:

1. Architectural Woodwork Standards WDMA I.S. 6A Grade: As directed Premium or Custom.
2. Finish: Architectural Woodwork Standards System 5, varnish, conversion.
3. Finish: Architectural Woodwork Standards System 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.

4. Finish: Architectural Woodwork Standards System 10, UV Curable, Water Based.
5. Finish: Architectural Woodwork Standards System 11, Polyurethane, Catalyzed.
6. Finish: WDMA I.S. 6A TR-4 Conversion Varnish.
7. Finish: WDMA I.S. 6A TR-6 Catalyzed Polyurethane.
8. Finish: WDMA I.S. 6A TR-8 UV Cured Acrylated Polyester/Urethane.
9. Staining: Match Architect's sample, As selected by Architect from manufacturer's full range or None required.
10. Effect: As directed Open-grain finish, Filled finish or Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
11. Sheen: As directed Satin or Semigloss.

F. Opaque Finish:

1. Architectural Woodwork Standards WDMA I.S. 6A Grade: Premium or Custom as directed.
2. Finish: Architectural Woodwork Standards System 5, Varnish, Conversion.
3. Finish: Architectural Woodwork Standards System 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
4. Finish: Architectural Woodwork Standards System 10, UV Curable, Water Based.
5. Finish: Architectural Woodwork Standards System 11, Polyurethane, Catalyzed.
6. Finish: WDMA I.S. 6A OP-4 Conversion Varnish.
7. Finish: WDMA I.S. 6A OP-6 Catalyzed Polyurethane.
8. Color: Match Architect's sample or As selected by Architect from manufacturer's full range as directed.
9. Sheen: As directed Satin, Semigloss or Gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware." or Section 087111 "Door Hardware (Descriptive Specification)" as directed

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated door frames according to NFPA 80.

a. Install frames level, plumb, true, and straight.

1) Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).

b. Anchor frames to anchors or blocking built in or directly attached to substrates.

1) Secure with countersunk, concealed fasteners and blind nailing.
2) Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

c. For shop-finished items, use filler matching finish of items being installed.

2. Install fire-rated doors according to NFPA 80.
3. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
b. As directed Provide 1/8 inch (3.2 mm), 1/4 inch (6.4 mm), 3/8 inch (10 mm) or 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
c. Where threshold is shown on Drawings or scheduled, provide 1/4 inch (6.4 mm) or 3/8 inch (10 mm) from bottom of door to top of threshold unless otherwise indicated.
d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

A. Inspection Agency: As directed Owner will engage or Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. As directed Provide inspection of installed Work through AWI's Quality Certification Program or WI's Certified Compliance Program, certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically

controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 081433.13 - WOOD TERRACE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-clad hinged wood-framed glass doors.
2. Vinyl-clad hinged wood-framed glass doors.
3. Unclad hinged wood-framed glass doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of hinged wood-framed glass door.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For hinged wood-framed glass doors.

D. Samples: For each type of hinged wood-framed glass door and for each color and texture specified, 12-inch-long (300-mm-long) section with weather stripping, glazing bead, and factory-applied color finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace hinged wood-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Hinged Door: As directed Two, Three or Five years from date of Substantial Completion.
b. Insulating Glass: As directed 10 or 20 years from date of Substantial Completion.
c. Laminated Glass: Five years from date of Substantial Completion.
d. Metal Finish: As directed Five, 10 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AMMA certified with label attached to each door.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: As directed Class R, Class LC, Class CW or As indicated on Drawings.
2. Minimum Performance Grade: As directed Grade 15, Grade 20, Grade 25, Grade 30, Grade 35, Grade 40, Grade 45, Grade 50 or As indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.54 Btu/sq. ft. x h x deg F (3.06 W/sq. m x K) or 0.56 Btu/sq. ft. x h x deg F (3.17 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.30 or 0.27 as directed.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection as directed.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 ALUMINUM-CLAD HINGED WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: Aluminum cladding with manufacturer's standard baked-on enamel finish, manufacturer's standard high-performance organic finish or manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight and complying with AAMA 2605.

1. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: As directed Unfinished, Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Manufacturer's standard stain-and-varnish finish.

1. Wood Species: As directed Manufacturer's standard species, Pine, Mahogany, Fir, Alder, Oak or Cherry as directed.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: Fabricate from wood components complying with indicated requirements. Provide factory-assembled door panels with narrow-profile, standard-profile, wide-profile stiles and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold: As directed Provide manufacturer's standard threshold, extruded aluminum threshold, extruded-aluminum threshold with oak nosing or pultruded fiberglass of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: As directed Bronze, Black, Beige, Mill finish or Manufacturer's standard.
2. Low-Profile Threshold: ADA-ABA compliant.

2.3 VINYL-CLAD HINGED WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: Vinyl-clad frames; vinyl-clad or high-performance color-coated finish door panels.

1. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: As directed Unfinished, Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Manufacturer's standard stain-and-varnish finish.

1. Exposed Wood Species: Manufacturer's standard species, Pine, Mahogany, Fir, Alder, Oak or Cherry.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: As directed Fabricate from wood components complying with indicated requirements. Provide factory-assembled door panels with narrow-profile, standard-profile, wide-profile stiles and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold: Provide manufacturer's standard threshold, extruded aluminum threshold, extruded-aluminum threshold with oak nosing or pultruded fiberglass of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: As directed Bronze, Black, Beige, Mill finish or Manufacturer's standard.
2. Low-Profile Threshold: ADA-ABA compliant.

2.4 UNCLAD HINGED WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: As directed Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Unfinished.

1. Wood Species: As directed Manufacturer's standard paint-grade species, Pine or Mahogany.
2. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: As directed Unfinished, Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Manufacturer's standard stain-and-varnish finish.

1. Wood Species: As directed Pine, Mahogany, Fir, Alder, Oak, Cherry or Manufacturer's standard paint-grade species.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: Fabricate from wood components complying with indicated requirements. As directed Provide factory-assembled door panels with narrow-profile, standard-profile or wide-profile stiles and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold: Provide manufacturer's standard threshold, extruded aluminum threshold, extruded-aluminum threshold with oak nosing or pultruded fiberglass of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: As directed Bronze, Black, Beige, Mill finish or Manufacturer's standard.

2. Low-Profile Threshold: ADA-ABA compliant.

2.5 GLAZING

A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements for windborne-debris resistance.

1. Glass: ASTM C1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
2. Safety Glazing Labeling: As directed Permanently mark safety glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
3. Insulating-Glass Units: ASTM E2190, certified through IgCC as complying with requirements of IgCC.

    a. Filling: Fill space between glass lites with air or argon as directed.
    b. Low-E coating.

2.6 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with wood and aluminum cladding complying with AAMA 907; designed to smoothly operate, tightly close, and securely lock hinged wood-framed glass doors and sized to accommodate panel weight and dimensions.

B. Lock: Install manufacturer's standard keyed multipoint locking device on each operable panel, lockable from the inside only and outside.

2.7 INSECT SCREENS

A. General: Design hinged wood-framed glass doors to accommodate screens in a tight-fitting, removable arrangement. Provide swinging or sliding screen for each operable door panel. Comply with SMA 1201 as directed.

B. Insect Screen Frames: Manufacturer's standard extruded-aluminum or formed-tubular-aluminum members, with mitered or coped joints, concealed fasteners, adjustable rollers, and removable PVC or PE spline/anchor concealing edge of mesh. Provide finish to match door frame.

C. Glass-Fiber Mesh Fabric: As directed ASTM D3656, 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645-sq. mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656.

2.8 ACCESSORIES

A. Grilles (False Muntins): Provide grilles in designs indicated, for removable application to inside of each panel lite.

1. Type: As directed Interior, removable, Exterior and interior, removable, Exterior and interior, adhered to glass or with between-glass grille.
2. Material: To match adjacent finish of door panel.
3. Design: As directed Rectangular, Diamond or As indicated on Drawings.
4. Bar Width: Not less than 3/4 inch (19 mm), 7/8 inch (22 mm) or 1-1/8 inches (28 mm) wide as directed.
5. Bar Profile: Beveled, Ovolo or Square as directed.
6. Color: White, Bronze or As selected by Architect from manufacturer's full range.

B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for hinged wood-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.9 FABRICATION

A. Fabricate hinged wood-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Weather Stripping: Provide full-perimeter weather stripping for each door panel unless otherwise indicated.

C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

D. Factory-Glazed Fabrication: Glaze hinged aluminum-framed glass doors in the factory.

2.10 WOOD FINISHES

A. Factory-Applied Primer: Provide manufacturer's standard factory-applied prime coat complying with WDMA T.M. 11. on exposed exterior and interior wood surfaces as directed.

B. Factory-Applied Color Finish: Provide manufacturer's standard factory-applied finish complying with WDMA T.M. 12. Apply finish to exposed exterior and interior wood surfaces.

1. Color: As directed White, Brown, Gray or As selected by Architect from manufacturer's full range.

2.11 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

B. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing hinged doors, hardware, accessories, and other components.

B. Windborne-Debris Resistance: Anchor hinged wood-framed glass doors that have been tested for windborne debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris resistance testing.

C. Install hinged wood-framed glass doors level, plumb, square, true to line; without distortion, warp, or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction. Comply with ASTM E2112.

D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E2112.

F. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and weathertight closure.

G. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

END OF SECTION 081433.13

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of access door and frame and for each finish specified.

C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: As directed Wall, Ceiling or Wall and ceiling.

3. Uncoated Steel Sheet for Door: As directed Nominal 0.060 inch (1.52 mm), 16 gage, factory primed or finished.
4. Metallic-Coated Steel Sheet for Door: As directed Nominal 0.064 inch (1.63 mm), 16 gage, factory primed or finished.
5. Stainless Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, ASTM A480/A480M No. 4 finish.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: As directed Cam latch, screwdriver operated, Cam latch, key operated, Cam latch, hex-head wrench operated, Cam latch, pinned-hex-head wrench operated, Cam latch, spanner-head wrench operated, Latch bolt, knurled-knob operated, Latch bolt, key operated, Prepared for mortise cylinder, As indicated on Drawings or As indicated in schedule with interior release.

B. Flush Access Doors with Concealed Flanges:
1. Description: As directed Face of door flush with frame; with concealed flange for gypsum board or plaster installation and concealed hinge.
2. Locations: As directed Wall, Ceiling or Wall and ceiling.
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed or finished as directed.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage factory primed or finished.
5. Stainless Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, ASTM A480/A480M No. 4 finish.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: As directed Cam latch, screwdriver operated, Cam latch, key operated, Cam latch, hex-head wrench operated, Cam latch, pinned-hex-head wrench operated, Cam latch, spanner-head wrench operated, Latch bolt, knurled-knob operated, Latch bolt, key operated, Prepared for mortise cylinder, As indicated on Drawings or As indicated in schedule with interior release.

C. Lightweight Flush Access Doors:
1. Description: Face of door flush with exposed flange, with exposed piano hinge; frameless for surface installation.
2. Locations: As directed Wall, Ceiling or Wall and ceiling.
3. Uncoated Steel Sheet for Door: As directed Nominal 0.018 inch (0.46 mm), 26 gage, factory primed or finished.
4. Metallic-Coated Steel Sheet for Door: As directed Nominal 0.022 inch (0.56 mm), 26 gage, factory primed or finished.
5. Frame Material: Aluminum, nominal 0.045 inch (1.15 mm), mill finish.
6. Latch and Lock: As directed Cam latch, screwdriver operated, Cam latch, key operated, Cam latch, hex-head wrench operated, Cam latch, pinned-hex-head wrench operated, Cam latch, spanner-head wrench operated, Latch bolt, knurled-knob operated, Latch bolt, key operated, Prepared for mortise cylinder, As indicated on Drawings or As indicated in schedule with interior release.

D. Interior Flush GFRG Access Doors with Concealed Flanges:
1. Description: As directed Face of drop-in or concealed-hinge door flush with frame, with concealed flange for gypsum board installation.
2. Locations: As directed Wall, Ceiling or Wall and ceiling.
3. Door Size: As directed.

4. Door Type As directed Drop in, radius corner, Drop in, square corner, Concealed-hinge, radius corner or Concealed-hinge, square corner.
5. Door and Frame Material: Unpainted glass-fiber-reinforced gypsum, with frames reinforced for hardware and fastenings.
6. Latch and Lock: As directed Cam latch, screwdriver operated, Cam latch, key operated, As indicated on Drawings or As indicated in schedule.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:
1. Description: As directed Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal or uninsulated; with exposed flange, self-closing door, and concealed hinge.
2. Locations: As directed Wall, Ceiling or Wall and ceiling.
3. Fire-Resistance Rating: As directed Not less than that indicated, that of adjacent construction, 45 minutes, 1 hour, 1-1/2 hours, 2 hours or 3 hours.
4. Temperature-Rise Rating: As directed 450 deg F (250 deg C) or 250 deg F (139 deg C) at the end of 30 minutes.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed or finished.
6. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage, factory primed or finished.
7. Stainless Steel Sheet for Door: Nominal 0.038 inch (0.95 mm), 20 gage, ASTM A480/A480M No. 4 finish.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Self-latching door hardware, operated by knurled-knob, operated by key, prepared for mortise cylinder, as indicated on Drawings, as indicated in schedule with interior release.

B. Fire-Rated, Flush Access Doors with Concealed Flanges:
1. Description: As directed Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal or uninsulated; with concealed flange for gypsum board or plaster installation, self-closing door, and concealed hinge.
2. Locations: as directed Wall, Ceiling or Wall and ceiling.
3. Fire-Resistance Rating: As directed Not less than that indicated, that of adjacent construction, 45 minutes, 1 hour, 1-1/2 hours, 2 hours or 3 hours.
4. Temperature-Rise Rating: As directed 450 deg F (250 deg C) or 250 deg F (139 deg C) at the end of 30 minutes.
5. Uncoated Steel Sheet for Door: As directed Nominal 0.036 inch (0.91 mm), 20 gage, factory primed or finished.
6. Metallic-Coated Steel Sheet for Door: As directed Nominal 0.040 inch (1.02 mm), 20 gage, factory primed or finished.
7. Stainless Steel Sheet for Door: Nominal 0.038 inch (0.95 mm), 20 gage, ASTM A480/A480M No. 4 finish.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: As directed Self-closing, self-latching door hardware, operated by knurled-knob, operated by key, prepared for mortise cylinder, as indicated on Drawings or as indicated in schedule, with interior release.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Stainless Steel Sheet, Strip, Plate, and Flat Bars: As directed ASTM A666, Type 304 or Type 316. Remove tool and die marks and stretch lines, or blend into finish.

E. Frame Anchors: Same material as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware." Section 087111 "Door Hardware (Descriptive Specification)."

2.6 FINISHES

A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

    a. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

3.2 FIELD QUALITY CONTROL

A. Inspection Agency: As directed Owner will engage or Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

END OF SECTION 083113

SECTION 083113.53 - SECURITY ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes security access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of security access door and frame and for each finish specified.

C. Product Schedule: For security access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 SECURITY ACCESS DOORS AND FRAMES

A. Medium-Security Flush Access Doors with Exposed Flanges:

1. Locations: Wall, Ceiling or Wall and ceiling.
2. Uncoated Steel Sheet for Door: Nominal 0.105 inch (2.66 mm), 12 gauge or Nominal 0.075 inch (1.90 mm), 14 gauge; factory primed.
3. Metallic-Coated Steel Sheet for Door: Nominal 0.108 inch (2.74 mm), 12 gauge or Nominal 0.079 inch (2.01 mm), 14 gauge; factory primed.
4. Frame Material: Same material, thickness, and finish as door or Minimum 3/16-by-1-1/2-by-1-1/2-inch (4.7-by-38-by-38-mm) angle welded with joints ground smooth; factory primed.
5. Hinges: Manufacturer's standard security hinge.
6. Latch and Lock: Detention deadbolt with parametric key, Cam latch, cylinder key operated, Cam latch, hex-head wrench operated, Cam latch, pinned-hex-head wrench operated, Cam latch, spanner-head wrench operated, prepared for mortise cylinder, as indicated on Drawings or as indicated in schedule with interior release]

B. High-Security Flush Access Doors:

1. Locations: Wall, Ceiling or Wall and ceiling.
2. Uncoated Steel Sheet for Door: Nominal 0.134 inch (3.42 mm), 10 gauge; factory primed.
3. Metallic-Coated Steel Sheet for Door: Nominal 0.138 inch (3.50 mm), 10 gauge; factory primed.

4. Frame Material: Same material, thickness, and finish as door or minimum 3/16-by-2-by-2-by-3-inch (4.7-by-50-by-50-by-76-mm) angle welded with joints ground smooth; factory prime.
5. Hinges: Manufacturer's standard security hinge.
6. Latch and Lock: Detention deadbolt with parametric key, Cam latch, cylinder key operated, Cam latch, hex-head wrench operated, Cam latch, pinned-hex-head wrench operated, Cam latch, spanner-head wrench operated, prepared for mortise cylinder, as indicated on Drawings or as indicated in schedule with interior release.

C. Maximum-Security Flush Access Doors:

1. Locations: Wall, Ceiling or Wall and ceiling.
2. Uncoated Steel Sheet for Door: Nominal 0.180 inch (4.55 mm), 7 gauge; factory primed.
3. Metallic-Coated Steel Sheet for Door: Nominal 0.183 inch (4.65 mm), 7 gauge; factory primed.
4. Frame: Minimum 3/16-by-2-by-2-by-3-inch (4.7-by-50-by-50-by-76-mm) angle welded with joints ground smooth.
5. Hinges: Heavy-duty steel welded to door and frame.
6. Latch and Lock: Detention deadbolt with parametric key, prepared for mortise cylinder, as indicated on Drawings or as indicated in schedule with interior release.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Frame Anchors: Same type as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware" or Section 087111 "Door Hardware ".

2.4 FINISHES

A. Factory-Primed Finish: Apply manufacturer's standard lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113.53

SECTION 083213 - SLIDING ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sliding aluminum-framed glass doors for exterior locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sliding aluminum-framed glass doors.

C. Samples: For each exposed product and for each color specified, 12-inch-long (300-mm-long) section with weather stripping, glazing bead, and factory-applied color finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating sliding aluminum-framed glass doors that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of sliding aluminum-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Sliding Door: Three or Five years from date of Substantial Completion, as directed.
b. Insulating-Glass Units: 10 or 20 years from date of Substantial Completion, as directed.
c. Laminated Glass: Five years from date of Substantial Completion, as directed.
d. Aluminum Finish: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AAMA certified with label attached to each door.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: Class R, Class LC, Class CW, Class AW or as indicated on Drawings.
2. Minimum Performance Grade: Grade 15, Grade 20, Grade 25, Grade 30, Grade 35, Grade 40, Grade 45, Grade 50, as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.30 or 0.27.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.3 SLIDING ALUMINUM-FRAMED GLASS DOORS

A. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.

B. Threshold and Sill Cap/Track: Provide extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated **and to drain to the exterior** with manufacturer's standard finish.

1. Low-Profile Floor Track: ADA-ABA compliant.

2.4 GLAZING

A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements for windborne-debris resistance or comply with requirements indicated in Section 088000 "Glazing".

1. Glass: ASTM C1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
2. Safety Glazing Labeling: Permanently mark safety glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
3. Insulating-Glass Units: ASTM E2190 certified through IGCC as complying with requirements of IGCC]

a. Filling: Fill space between glass lites with air or argon.
b. Low-E coating.

2.5 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding aluminum-framed glass doors.

B. Lock: Install manufacturer's keyed cylinder lock and multipoint locking device on each movable panel, lockable from the inside only and outside. Adjust locking device to allow unobstructed movement of the panel across adjacent panel in the direction indicated.

2.6 INSECT SCREENS

A. General: Design sliding aluminum-framed glass doors to accommodate screens in a tight-fitting, removable arrangement, fully integrated with door frame. Provide screen for each operable door panel.

B. Glass-Fiber Mesh Fabric: ASTM D3656, 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645-sq.-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656.

1. Mesh Color: Manufacturer's standard, Charcoal gray or Silver gray.

2.7 ACCESSORIES

A. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding aluminum-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.8 FABRICATION

A. Fabricate sliding aluminum-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Weather Stripping: Provide full-perimeter weather stripping for each door panel.

C. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.

D. Factory-Glazed Fabrication: Glaze sliding aluminum-framed glass doors in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or s selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing doors, hardware, accessories, and other components.

B. Windborne-Debris Resistance: Anchor sliding aluminum-framed glass doors that have been tested for windborne-debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris resistance testing.

C. Install sliding aluminum-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.

D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

E. Install sliding aluminum-framed glass doors and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.

F. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

G. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

END OF SECTION 083213

SECTION 083219 - SLIDING WOOD-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-clad sliding wood-framed glass doors.
2. Vinyl-clad sliding wood-framed glass doors.
3. Unclad sliding wood-framed glass doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As Directed.

C. Shop Drawings: For sliding wood-framed glass doors.

D. Samples: For each exposed product and for each color specified, 12-inch long (300-mm long) section with weather stripping, glazing bead, and factory-applied color finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE: As directed.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace sliding wood-framed glass doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Sliding Door: Two, Three or Five years from date of Substantial Completion, as directed.

b. Insulating Glass: 10 or 20 years from date of Substantial Completion, as directed.
c. Laminated Glass: Five years from date of Substantial Completion, as directed.
d. Metal Finish: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AAMA certified with label attached to each door.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: Class R, Class LC, Class CW or as indicated on Drawings.
2. Minimum Performance Grade: Grade 15, Grade 20, Grade 25, Grade 30, Grade 35, Grade 40, Grade 45, Grade 50 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.54 Btu/sq. ft. x h x deg F (3.06 W/sq. m x K) or 0.56 Btu/sq. ft. x h x deg F (3.17 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.30 or 0.27.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 ALUMINUM-CLAD SLIDING WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: Aluminum cladding with manufacturer's standard baked-on enamel finish, manufacturer's standard high-performance organic finish or manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight and complying with AAMA 2605.

1. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: Unfinished, manufacturer's standard factory-applied primer, manufacturer's standard factory-applied color finish or manufacturer's standard stain-and varnish-finish.

1. Wood Species: Manufacturer's standard species, Pine, Mahogany, Fir, Alder, Oak or Cherry.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: Fabricate from wood components complying with indicated requirements. Provide factory-assembled narrow-profile, standard-profile or wide-profile door panels and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold and Sill Cap/Track: Provide pultruded fiberglass threshold with polycarbonate track, extruded-aluminum threshold and track, extruded-aluminum threshold and track with nonmagnetic stainless-steel cover or manufacturer's standard threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: Bronze, Black, Beige, Mill finish or Manufacturer's standard]
2. Low-Profile Floor Track: ADA-ABA compliant.

2.3 VINYL-CLAD SLIDING WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: Vinyl-clad frames; vinyl-clad or high performance color-coated finish door panels.

1. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: Unfinished, Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Manufacturer's standard stain-and-varnish finish.

1. Wood Species: Manufacturer's standard species, Pine, Mahogany, Fir, Alder, Oak or Cherry.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: Fabricate from wood components complying with indicated requirements. Provide factory-assembled narrow-profile, standard-profile or wide-profile door panels and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and

surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold and Sill Cap/Track: Provide pultruded fiberglass threshold with polycarbonate track, extruded-aluminum threshold and track, extruded-aluminum threshold and track with nonmagnetic stainless-steel cover or manufacturer's standard threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: Bronze, Black, Beige, Mill finish or Manufacturer's standard.
2. Low-Profile Floor Track: ADA-ABA compliant.

2.4 UNCLAD SLIDING WOOD-FRAMED GLASS DOORS

A. Exterior Surfaces: Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Unfinished.

1. Wood Species: Manufacturer's standard paint-grade species, Pine or Mahogany.
2. Color: As selected by Architect from manufacturer's full range.

B. Interior Surfaces: Unfinished, Manufacturer's standard factory-applied primer, Manufacturer's standard factory-applied color finish or Manufacturer's standard stain-and-varnish finish.

1. Wood Species: Pine, Mahogany, Fir, Alder, Oak, Cherry or Manufacturer's standard paint-grade species.
2. Color: As selected by Architect from manufacturer's full range.

C. Frames and Door Panels: Fabricate from wood components complying with indicated requirements. Provide factory-assembled narrow-profile, standard-profile or wide-profile door panels and factory-assembled or field-assembled frames.

1. True Divided Lites: Provide glazing with true muntins resulting in individually glazed lites, in pattern indicated.

D. Wood Components: Manufacturer's standard LVL or fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

E. Threshold and Sill Cap/Track: Provide pultruded fiberglass threshold with polycarbonate track, extruded-aluminum threshold and track, extruded-aluminum threshold and track with nonmagnetic stainless-steel cover or manufacturer's standard threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to exterior.

1. Color: Bronze, Black, Beige, Mill finish or Manufacturer's standard.
2. Low-Profile Floor Track: ADA-ABA compliant.

2.5 GLAZING

A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements for windborne-debris resistance.

1. Glass: ASTM C1036, Type 1, q3, Category II safety glass complying with testing requirements in 16 CFR 1201.
2. Safety Glazing Labeling: Permanently mark safety glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
3. Insulating-Glass Units: ASTM E2190, certified through IgCC as complying with requirements of IgCC.

    a. Filling: Fill space between glass lites with air or argon.
    b. Low-E coating.

2.6 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with wood and aluminum cladding complying with AAMA 907; designed to smoothly operate, tightly close, and securely lock sliding wood-framed glass doors; and sized to accommodate panel weight and dimensions.

B. Lock: Install manufacturer's keyed cylinder lock and multipoint locking device on each movable panel, lockable from the inside only or and outside, as directed. Adjust locking device to allow unobstructed movement of the panel across adjacent panel in the direction indicated.

2.7 INSECT SCREENS

A. General: Design sliding wood-framed glass doors to accommodate screens in a tight-fitting, removable arrangement fully integrated with door frame. Locate screens on the inside or outside of door and provide for each operable door panel. Comply with SMA 1201.

B. Insect Screen Frames: Manufacturer's standard extruded-aluminum or formed-tubular-aluminum members, with mitered or coped joints, concealed fasteners, adjustable rollers, and removable PVC or PE spline/anchor concealing edge of mesh. Provide finish to match door frame.

C. Glass-Fiber Mesh Fabric: ASTM D3656, 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645-sq.-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656.

2.8 ACCESSORIES

A. Grilles (False Muntins): Provide grilles in designs indicated, for removable application to inside of each panel lite.

1. Type: Interior, removable, Exterior and interior, removable, Exterior and interior, adhered to glass or with between-glass grille.
2. Material: To match adjacent finish of door panel.
3. Design: Rectangular, Diamond or as indicated on Drawing.
4. Bar Width: Not less than 3/4 inch (19 mm), 7/8 inch (22 mm) or 1-1/8 inches (28 mm) wide.
5. Bar Profile: Beveled, Ovolo or Square.
6. Color: White, Bronze or as selected by Architect from manufacturer's full range.

B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding wood-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.9 FABRICATION

A. Fabricate sliding wood-framed glass doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Weather Stripping: Provide full-perimeter weather stripping for each door panel unless otherwise indicated.

C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

D. Factory-Glazed Fabrication: Glaze sliding wood-framed glass doors in the factory.

2.10 WOOD FINISHES

A. Factory-Applied Primer: Provide manufacturer's standard factory-applied prime coat complying with WDMA T.M. 11. Factory-applied prime coat on exposed exterior and interior wood surfaces, as directed.

B. Factory-Applied Color Finish: Provide manufacturer's standard factory-applied finish complying with WDMA T.M. 12. Apply finish to exposed exterior and interior wood surfaces.

1. Color: White, Brown, Gray or as selected by Architect from manufacturer's full range.

2.11 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing sliding doors, hardware, accessories, and other components.

B. Windborne-Debris Resistance: Anchor sliding wood-framed glass doors that have been tested for windborne-debris resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in windborne-debris resistance testing.

C. Install sliding wood-framed glass doors level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction. Comply with ASTM E2112.

D. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E2112, Section 5.12, "Dissimilar Materials."

F. Adjust operating panels and screens to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and weathertight closure.

G. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

END OF SECTION 083219

SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Counter doors.
2. Fire-rated counter doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for door-opening framing and corner guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Temperature-Rise Limit: Where indicated or at exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
2. Smoke Control: Where indicated or in corridors and smoke barriers] provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.

B. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000, 20,000, 50,000, 100,000 or 200,000.

C. STC Rating: 26.

D. Door Curtain Material: Galvanized steel, Stainless steel or Aluminum.

E. Door Curtain Slats: Curved or Flat profile slats of 1-1/4-inch (32-mm), 1-1/2-inch (38-mm) center-to-center height.

1. Perforated Slats: Approximately 1/16-inch (1.6 mm) pinholes, 3/32-inch (2.4 mm) pinholes or 7/8-inch (22 mm) wide by 3/8-inch (10 mm) high slots.
2. Fenestrated Slats: Approximately 3 by 5/8-inch (76 by 16-mm), 4 by 5/8-inch (102 by 16-mm) or 10 by 1-5/8-inch (254 by 41-mm) openings spaced approximately 1-1/2 inches (38 mm) apart and beginning 12 inches (305 mm) from jamb guides.
3. Vision Panels: Approximately 10 by 1-5/8-inch (254 by 41 mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in two or three rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
4. Insulated-Slat Interior Facing: Metal or Plastic.

F. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel, stainless steel or aluminum extrusion and finished to match door.

G. Curtain Jamb Guides: Galvanized steel, Stainless steel or Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise. Provide removable post(s) and jamb guides where indicated on Drawings.

H. Hood: Match curtain material and finish, Galvanized steel, Stainless steel or Aluminum.

1. Mounting: Face of wall, between jambs or as indicated on Drawings.

I. Integral Frame, Hood, and Fascia: Galvanized or Stainless steel.

1. Mounting: Face of wall, between jambs] or as indicated on Drawings.

J. Sill Configuration: No sill or integral metal sill.

K. Locking Devices: Equip door with slide bolt for padlock, locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side, Cremone-type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder. outside only, with cylinder or inside and outside with cylinders.

L. Manual Door Operator: Push-up operation, Chain-hoist operator, Manufacturer's standard crank operator or awning-crank operator.

M. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, standard duty, up to 25 cycles per hour and up to 90 cycles per day, medium duty, up to 12 cycles per hour and up to 50 cycles per day or light duty, up to 10 cycles per hour.
2. Motor Exposure: Interior or Exterior, wet, and humid.
3. Motor Electrical Characteristics:

    a. Horsepower: ½, 1, 2 or 3 hp.
    b. Voltage: 115-V ac, 208-V ac or 230-V ac, single phase, 60 Hz.
    c. Voltage: 208-V ac, 230-V ac or 460-V ac, three phase, 60 Hz.

4. Emergency Manual Operation**:** Push-up, Chain or Crank type.
5. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar, pneumatic sensor edge on bottom bar or; self-monitoring type.
6. Control Station(s): Interior-side mounted, Exterior-side mounted or where indicated on Drawings.

N. Curtain Accessories: Equip door with smoke seals, weatherseals, astragal, push/pull handles, pull-down strap, poll hook and automatic closing device.

O. Door Finish:

1. Aluminum Finish: Mill, Clear anodized, Light bronze anodized, Medium bronze anodized, Dark bronze anodized, Black anodized, Anodized color matching Architect's sample or anodized color as selected by Architect from full range of industry colors and color densities.
2. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching Architect's sample or color as selected by Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled) or ASTM A480/A480M No. 4 (polished directional satin).
5. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face or PVC plastic.

2.3 FIRE-RATED COUNTER DOOR ASSEMBLY

A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000, 20,000, 50,000, 100,000 or 200,000.

C. Fire Rating: ¾ hour, 1 hour, 1-1/2 hours, 3 hours, 4 hours or with temperature-rise limit and with smoke control.

D. STC Rating: 27.

E. Door Curtain Material: Galvanized or Stainless steel.

F. Door Curtain Slats: Curved or Flat profile slats of 1-1/4-inch (32-mm) or 1-1/2-inch (38-mm) center-to-center height.

1. Vision Panels: Approximately 10 by 1-5/8-inch (254 by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in two or three rows of slats at height indicated on Drawings; installed with fire-rated vision-panel glazing.
2. Insulated-Slat Interior Facing: Metal.

G. Curtain Jamb Guides: Galvanized or Stainless steel with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish, Galvanized steel or Stainless steel.

1. Mounting: Face of wall, between jambs or as indicated on Drawings.

I. Integral Frame, Hood, and Fascia: Galvanized or Stainless steel.

1. Mounting: Face of wall, between jambs or as indicated on Drawings.

J. Sill Configuration: No sill, integral metal sill or fire-rated, laminate counter.

K. Locking Devices: Equip door with slide bolt for padlock, locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side or cremone-type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder, outside only, with cylinder or inside and outside with cylinders.

L. Manual Door Operator: Push-up operation, Chain-hoist operator, Manufacturer's standard crank operator or awning-crank operator.

M. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, Standard duty, up to 25 cycles per hour and up to 90 cycles per day, Medium duty, up to 12 cycles per hour and up to 50 cycles per day or Light duty, up to 10 cycles per hour.
2. Motor Exposure: Interior or exterior, wet, and humid.
3. Motor Electrical Characteristics:

    a. Horsepower: ½, **1**, **2** or **3** hp.
    b. Voltage: 115-V ac, 208-V ac or 230-V ac, single phase, 60 Hz.
    c. Voltage: 208-V ac, 230-V ac or 460-V ac, three phase, 60 Hz.

4. Emergency Manual Operation: Push-up, Chain or Crank type.
5. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar, pneumatic sensor edge on bottom bar; self-monitoring type.
6. Control Station(s): Interior-side mounted, exterior-side mounted or where indicated on Drawings.

N. Curtain Accessories: Equip door with smoke seals, automatic closing device, astragal, push/pull handles, pull-down strap, poll hook and items as directed.

O. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled) or ASTM A480/A480M No. 4 (polished directional satin).
4. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
4. Plastic Interior Curtain-Slat Facing: Extruded PVC plastic with maximum flame-spread index of 25, 75 or 200 and smoke-developed index of 450, according to ASTM E84 or UL 723.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware", specified in Section 087111 "Door Hardware (Descriptive Specification)", standard with manufacturer and keyed to building keying system.
2. Keys: Two or Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

D. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.

E. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

F. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Automatic-closing device shall be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
4. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTER DOOR ACCESSORIES

A. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with ASTM A480/A480M No. 4 finish.

B. Fire-Rated, Laminate Counter: Fire-door manufacturer's high-pressure, decorative laminate-covered countertop; UL or ITS tested and labeled for 1-1/2-hour fire rating for approved use with fire-door assembly.

2.10 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.11 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) or 30-lbf (133-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf (111-N) or 30-lbf (133-N) force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.12 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.

2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N) or 30 lbf (133 N).

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Fire-Rated Doors: Install according to NFPA 80.

C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform acceptance testing according to NFPA 80.

    a. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.

2. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
3. Operational Test: After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.
2. Insulated service doors.
3. Fire-rated service doors.
4. Fire-rated, insulated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices detectors or replaceable fusible links, and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance data.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Two** years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Temperature-Rise Limit: Where indicated or at exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
2. Smoke Control: Where indicated or in corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.

B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" or the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

C. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on Drawings or Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.

D. Windborne-Debris Impact Resistance: Provide glazed and impact-protective overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1, ASTM E1996 for Wind Zone 2, ASTM E1996 for Wind Zone 3, ASTM E1996 for Wind Zone 4 or DASMA 115 for basic enhanced protection.

1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.1 m) of grade.

E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

A. Service or Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000, 20,000, 50,000, 100,000 or 200,000.

C. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W), 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W) or 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

D. Door Curtain Material: Galvanized steel, Stainless steel or Aluminum.

E. Door Curtain Slats: Curved or Flat profile slats of 1-7/8-inch (48-mm), 2-5/8-inch (67-mm) or 3-1/4-inch (83-mm) center-to-center height.

1. Perforated Slats: Approximately 1/16-inch (1.6-mm) pinholes, 3/32-inch (2.4-mm) pinholes or 7/8-inch- (22-mm-) wide by 3/8-inch- (10-mm-) high slots.
2. Fenestrated Slats: Approximately 3 by 5/8-inch (76 by 16-mm), 4 by 5/8-inch (102- by 16-mm) or 10 by 1-5/8-inch (254 by 41-mm) openings spaced approximately 1-1/2 inches (38 mm) apart and beginning 12 inches (305 mm) from jamb guides.
3. Vision Panels: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in two or three rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
4. Insulated-Slat Interior Facing: Metal or Plastic.

F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel, stainless steel or aluminum extrusions and finished to match door.

G. Curtain Jamb Guides: Galvanized steel, Stainless steel or Aluminum with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish, Galvanized steel, Stainless steel or Aluminum.

1. Mounting: Face of wall, between jambs or as indicated on Drawings.

I. Locking Devices: Equip door with slide bolt for padlock, locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side, Cremone-type, both jamb sides locking bars, operable from inside with thumbturn outside with cylinder, outside only, with cylinder or inside and outside with cylinders.

J. Manual Door Operator: Push-up operation, Chain-hoist operator, Manufacturer's standard crank operator, Awning-crank operator or wall-crank operator.

K. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, Standard duty, up to 25 cycles per hour and up to 90 cycles per day, Medium duty, up to 12 cycles per hour and up to 50 cycles per day or Light duty, up to 10 cycles per hour.
2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
3. Motor Exposure: Interior or exterior, wet, and humid.
4. Motor Electrical Characteristics:

    a. Horsepower: ½, 1, 2 or 3 hp.
    b. Voltage: 115-V ac, 208-V ac or 230-V ac, single phase, 60 Hz.
    c. Voltage: 208-V ac, 230-V ac or 460-V ac, three phase, 60 Hz.

5. Emergency Manual Operation: Push-up, Chain or Crank type.
6. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar or pneumatic sensor edge on bottom bar or self-monitoring type.
7. Control Station(s): Interior mounted, exterior mounted or where indicated on Drawings.
8. Other Equipment: Audible and visual signals or Portable radio-control system.

L. Curtain Accessories: Equip door with smoke seals, weatherseals, astragal, push/pull handles, pull-down strap, poll hook and automatic-closing device.

M. Door Finish:

1. Aluminum Finish: Mill, Clear anodized, Light bronze anodized, Medium bronze anodized, Dark bronze anodized, Black anodized, Anodized color matching Architect's sample or anodized color as selected by Architect from full range of industry colors and color densities.
2. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled) or ASTM A480/A480M No. 4 (polished directional satin).
5. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face, Finish as indicated by manufacturer's designations, finish matching Architect's sample or Finish as selected by Architect from manufacturer's full range.

2.3 FIRE-RATED DOOR ASSEMBLY

A. Fire-Rated Service or Insulated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000, 20,000, 50,000, 100,000 or 200,000.

C. Fire Rating: 3/4 hour, 1 hour, 1-1/2 hours, 3 hours, 4 hours or with temperature-rise limit and with smoke control.

D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W), 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W) or 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

E. Door Curtain Material: Galvanized or Stainless steel.

F. Door Curtain Slats: Curved or Flat profile slats of 1-7/8-inch (48-mm), 2-5/8-inch (67-mm) or 3-1/4-inch (83-mm) center-to-center height.

1. Vision Panels: Approximately 10 by 1-5/8-inch (254 by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in two or three rows of slats at height indicated on Drawings; installed with fire-rated vision-panel glazing.
2. Insulated-Slat Interior Facing: Metal.

G. Curtain Jamb Guides: Galvanized or Stainless steel with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish, Galvanized steel or Stainless steel.

1. Mounting: Face of wall, between jambs or as indicated on Drawings.

I. Locking Devices: Equip door with slide bolt for padlock, locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side or Cremone-type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder, outside only, with cylinder or inside and outside with cylinders.

J. Manual Door Operator: Push-up operation, Chain-hoist operator, Manufacturer's standard crank operator, Awning-crank operator or Wall-crank operator.

K. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, Standard duty, up to 25 cycles per hour and up to 90 cycles per day, Medium duty, up to 12 cycles per hour and up to 50 cycles per day or Light duty, up to 10 cycles per hour.
2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
3. Motor Exposure: Interior or exterior, wet, and humid.
4. Motor Electrical Characteristics:

a. Horsepower: ½, 1, 2 or 3 hp.
b. Voltage: 115-V ac, 208-V ac or 230-V ac, single phase, 60 Hz.
c. Voltage: 208-V ac, 230-V ac or 460-V ac, three phase, 60 Hz.

5. Emergency Manual Operation: Push-up, Chain or Crank type.
6. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar, pneumatic sensor edge on bottom bar or self-monitoring type.
7. Control Station(s): Interior mounted, exterior mounted or where indicated on Drawings.
8. Other Equipment: Audible and visual signals or Portable radio-control system.

L. Curtain Accessories: Equip door with smoke seals, automatic-closing device, astragal, push/pull handles, pull-down strap poll hook and items as directed.

M. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as indicated by manufacturer's designations, Color matching Architect's sample or Color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled) or ASTM A480/A480M No. 4 (polished directional satin).
4. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face, Finish as indicated by manufacturer's designations, Finish matching Architect's sample or Finish as selected by Architect from manufacturer's full range.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm) and minimum aluminum thickness of 0.032 inch (0.80 mm).

4. Plastic Interior Curtain-Slat Facing: Extruded PVC plastic with maximum flame-spread index of 25, 75 or 200 and smoke-developed index of 450, according to ASTM E84 or UL 723.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware", specified in Section 087111 "Door Hardware (Descriptive Specification)" or standard with manufacturer and keyed to building keying system.
2. Keys: Two or Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

C. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

D. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

E. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.

F. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

G. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Testing for manually operated doors shall allow resetting by opening the door without retensioning the counterbalance mechanism or release mechanism for motor-operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
4. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) or 30-lbf (133-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf (111-N) or 30-lbf

(133-N) force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.11 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

    a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N) or 30 lbf (133 N).

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

I. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

J. Portable Radio-Control System: Consisting of one or two of the following per door operator:

1. Three-channel universal coaxial receiver to open, close, and stop door.
2. Portable control device to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Fire-Rated Doors: Install according to NFPA 80.

C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083326 - OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes open-curtain overhead coiling grilles.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, angle-framing of grille opening, corner guards, and bollards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling grille and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices, and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" or the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of grilles that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Overhead coiling grilles shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 OPEN-CURTAIN GRILLE ASSEMBLY

A. Open-Curtain Grille: Overhead coiling, countertop grille with a curtain having a network of horizontal rods that interconnect with vertical links.

B. Operation Cycles: Grille components and operators capable of operating for not less than 10,000, 20,000, 50,000, 100,000 or 200,000.

C. Grille Curtain Material: Aluminum, Stainless steel or Galvanized steel.

1. Rod Spacing: Approximately 1-1/2 inches (38 mm), 2 inches (51 mm) or 3 inches (76 mm) o.c.
2. Link Spacing: Approximately 3 inches (76 mm), 6 inches (152 mm) or 9 inches (228 mm) apart in a straight in-line or brick (staggered) pattern.
3. Spacers: Metal tubes matching curtain material or PVC.

D. Bottom Bar: Continuous tubular shape, channel or doubled angles, fabricated from aluminum extrusion, hot-dip galvanized steel or stainless steel and finished to match grille.

E. Curtain Jamb Guides: Aluminum, Stainless steel or Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise. Provide removable post(s) and jamb guides where indicated on Drawings.

F. Hood: Match curtain material and finish, Aluminum, Stainless steel or Galvanized steel.

1. Mounting: Face of wall, between jambs, on mounting frame or as indicated on Drawings.

G. Locking Devices: Equip grille with slide bolt for padlock or locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side or Cremone-type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder, outside only, with cylinder or inside and outside with cylinders.

H. Manual Grille Operator: Push-up operation, Chain-hoist operator, Manufacturer's standard crank operator, Awning-crank operator or Wall-crank operator.

I. Electric Grille Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, Standard duty, up to 25 cycles per hour and up to 90 cycles per day, Medium duty, up to 12 cycles per hour and up to 50 cycles per day or Light duty, up to 10 cycles per hour.
2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
3. Motor Exposure: Interior or Exterior, wet, and humid.
4. Motor Electrical Characteristics:

    a. Horsepower: ½, 1, 2 or 3 hp.
    b. Voltage: 115-V ac, 208-V ac or 230-V ac, single phase, 60 Hz.
    c. Voltage: 208-V ac, 230-V ac or 460-V ac, three phase, 60 Hz.

5. Emergency Manual Operation: Push-up, Chain or Crank type.
6. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar, pneumatic sensor edge on bottom bar or self-monitoring type.
7. Control Station: Interior mounted, Exterior mounted or where indicated on Drawings.
8. Other Equipment: Audible and visual signals, Emergency-egress release or Self-opening mechanism.

J. Curtain Accessories: Equip grille with astragal or push/pull handles and poll hook.

K. Grille Finish:

1. Aluminum Finish: Mill, Clear anodized, Light bronze anodized, Medium bronze anodized, Dark bronze anodized Black anodized, Anodized color matching Architect's sample or anodized color as selected by Architect from full range of industry colors and color densities.
2. Baked-Enamel or Powder-Coat Finish: Color as indicated by manufacturer's designations, Color matching Architect's sample or color as selected by Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Stainless-Steel Finish: No. 2B (bright, cold rolled) or No. 4 (polished directional satin).
5. PVC Spacers: Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

2.3 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.

B. Bottom Bar: Manufacturer's standard continuous shape unless otherwise indicated, finished to match grille.

1. Astragal: Equip grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
2. Provide motor-operated grilles with combination bottom astragal and sensor edge.

C. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.5 HOODS AND ACCESSORIES

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

C. Push/Pull Handles: Equip push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille.

D. Pull-Down Strap: Provide pull-down straps for grilles more than 84 inches (2130 mm) high.

E. Pole Hooks: Provide pole hooks and poles for grilles more than 84 inches (2130 mm) high.

2.6 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware", specified in Section 087111 "Door Hardware (Descriptive Specification)" or standard with manufacturer and keyed to building keying system.
2. Keys: Two or Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

2.7 COUNTERBALANCE MECHANISM

A. General: Counterbalance grilles by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL GRILLE OPERATORS

A. General: Equip grille with manual grille operator by grille manufacturer.

B. Push-up Grille Operation: Lift handles and pull rope for raising and lowering grille, with counterbalance mechanism designed so that required lift or pull for grille operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) or 30-lbf (133-N) force for grille operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf (111-N) or 30-lbf (133-N) force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.9 ELECTRIC GRILLE OPERATORS

A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operation cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each grille assembly.

1. Electrical Characteristics: Minimum as indicated for each grille assembly. If not indicated, large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in grille opening without contact between grille and obstruction.

    a. Self-Monitoring Type: Designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, grille closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire-configured device designed to interface with grille operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type; NEMA ICS 6, Type 4 enclosure, key operated.

F. Emergency Manual Operation: Equip electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed 25 lbf (111 N) or 30 lbf (133 N).

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

I. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

J. Emergency-Egress Release: Flush, wall-mounted handle mechanism, for accessibility-code-compliant egress feature, not dependent on electric power. The release allows an unlocked grille to partially open without affecting limit switches to permit passage, and it automatically resets motor drive on return of handle to original position.

K. Self-Opening Mechanism: Automatic release mechanism triggered by smoke detector, emergency push-button station, fire alarm or power failure. When activated, the grille self-opens by means of a fail-safe operator to the fully open position without the need for power operation or battery backup systems. When the emergency push-button is reset, and the alarm is cleared and power is restored, the grille will operate normally.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports, according to manufacturer's written instructions and as specified.

B. Power-Operated Grilles: Install automatic garage grille openers according to UL 325.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION 083326

SECTION 083459 - VAULT DOORS AND DAY GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Burglary-resistance-rated vault door assemblies.
2. Fire-resistance-rated vault door assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vault door assemblies.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer and whose place of business is located not more than 2 hours' normal travel time from Project site.

PART 2 - PRODUCTS

2.1 BURGLARY-RESISTANCE-RATED VAULT DOOR ASSEMBLIES

A. Vault Door Assembly: Tested according to UL 608 and listed and labeled for burglary-resistance ratings indicated by a qualified testing agency.

B. Burglary-Resistance Rating: UL 608, Class M, 15 minutes, Class 1, 30 minutes, Class 2, one hour or Class 3, two hours networking time.

C. Factory-Installed Features:

1. Door-contact alarm device.
2. Heat detector.
3. Emergency vault ventilator complying with UL 680, with same burglary classification as vault door.
4. Pass-through port.
5. In-door telephone jack.
6. Stainless-steel back panel to conceal timelock.
7. Can be side lifted.

D. Hardware and Accessories:

1. Handle: Manufacturer's standard, Stainless-steel, spoked wheel or Stainless-steel hand wheel with rubber-grip perimeter.
2. Combination Locks: UL 768, Group 1, four-wheel mechanical type capable of no fewer than one million possible combinations.

    a. Quantity: Two or Three per door.

3. Timelock: UL 887 listed, three-movement, 144 or 199 hour timelock.
4. Day Guard Lock: Secures locking bar in open position to prevent lock in of personnel.

E. Day Gate: Controlled by key on nonsecure side and by knob on secure side.

1. Features:

    a. Deal window.
    b. Automatic closure.

F. Finish: Manufacturer's standard stainless-steel clad or factory-applied, baked-on coating finish applied to door, frame, and wall flanges.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.2 FIRE-RESISTANCE RATED VAULT DOOR ASSEMBLIES

A. Vault Door Assembly: Complying with NFPA 232, tested according to UL 155, and listed and labeled for fire-resistance ratings indicated by a qualified testing agency.

B. Fire-Resistance Rating: UL 155, Class 350, 2, 4 or 6 hours.

C. Hardware and Accessories:

1. Combination Lock: UL 768, Group 2, three-wheel, mechanical type, capable of not less than one million possible combinations.

a. Provide key locking dials.

2. Relocking Device: UL 140 separate relocking device that automatically deadlocks door bolts when lock is subjected to mechanical attack.
3. Escape Mechanism: Provide emergency operation of lock from vault side of door.
4. Door Closer: Automatic, with electromagnetic system and sensor that releases door on detection of heat or smoke; with 180-degree, hold-open position.

D. Day Gate: Controlled by key on nonsecure side and by lever on secure side.

E. Painted Finish: Manufacturer's standard factory-applied, baked-on coating applied to vault door, frame, and wall flanges.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install vault door assemblies complete with doors, frames, and accessories and according to requirements of assemblies' UL listing.

B. Touchup Painting: Immediately after erection, clean abraded areas of shop paint; paint exposed areas with same material used for shop painting.

1. Comply with SSPC-PA 1 for touching up shop-painted surfaces. Section 099123 "Interior Painting."

END OF SECTION 083459

SECTION 083463 - DETENTION DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Swinging detention doors.
2. Sliding detention doors.
3. Detention panels.
4. Detention frames.

1.2 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by a Detention Specialist or other entity.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: In addition to plans, elevations, sections, and attachment details, provide a schedule using same reference numbers for details and openings as those on Drawings:

D. Samples: For each exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

C. Anchor inspection reports.

D. Field quality-control reports.

1. Field quality-control certification, signed by Contractor and Detention Specialist.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain detention doors and frames from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 DETENTION DOOR AND FRAME ASSEMBLIES

A. Detention Door and Frame Assemblies: ASTM F1450 for security grades specified.

1. Bullet Resistance: Level 3 rated when tested according to UL 752.
2. Tool-Attack Resistance: Small-tool-attack-resistance rated when tested according to UL 437 and UL 1034.

B. Detention Frames: Comply with ASTM F1592 and removable stop test according to NAAMM-HMMA 863.

2.4 DETENTION DOORS

A. General: Provide flush-design detention doors of seamless hollow construction, 2 inches (51 mm) thick unless otherwise indicated. Construct detention doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges.

B. Core Construction: Provide the following core construction of same material as detention door face sheets, welded to both detention door faces:

1. Steel-Stiffened Core: 0.042-inch (1.0-mm) thick, steel vertical stiffeners extending full-door height, with vertical webs spaced not more than 4 inches (102 mm) apart, spot welded to face sheets a maximum of 3 inches (76 mm) o.c. Fill spaces between stiffeners with insulation.

C. Vertical Edge Channels: 0.123-inch (3.1-mm) thick, continuous channel of same material as detention door face sheets, extending full-door height at each vertical edge; welded to top and bottom channels to create a fully welded perimeter channel.

D. Top and Bottom Channels: 0.123-inch (3.1-mm) thick metal channel of same material as detention door face sheets, spot welded, not more than 4 inches (102 mm) o.c., to face sheets.

1. Reinforce top edge of detention door with 0.053-inch (1.3-mm) thick closing channel, welded so channel web is flush with top door edges.

E. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention door face sheets to comply with the following minimum thicknesses:

1. Full-Mortise Hinges and Pivots: 0.187 inch (4.7 mm) thick.
2. Maximum-Security Surface Hinges: 0.250 inch (6.3 mm) thick.
3. Strike Reinforcements: 0.187 inch (4.7 mm) thick.
4. Slide-Device Hanger Attachments: As recommended by device manufacturer.
5. Lock Fronts, Concealed Holders, and Surface-Mounted Closers: 0.093 inch (2.3 mm) thick.
6. All Other Surface-Mounted Hardware: 0.093 inch (2.3 mm) thick.
7. Lock Pockets: 0.123 inch (3.1 mm) thick at non-inmate side, welded to face sheet.

F. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware of same material as detention door face sheets, interconnected with UL-approved, 1/2-inch (12.7-mm) diameter conduit and connectors.

1. Access Plates: Where indicated for wiring installation, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least four security fasteners spaced not more than 6 inches (152 mm) o.c.

G. Interior Detention Doors: Construct interior doors to comply with NAAMM-HMMA 863 and as specified.

1. Security Grade 1 or Security Grade 2: Provide doors with face sheets of 0.093-inch (2.3-mm) minimum-thickness, cold-rolled steel or 0.093-inch 2.3-mm) minimum-thickness, metallic-coated, cold-rolled steel.

2. Security Grade 3 or Security Grade 4: Provide doors with face sheets of 0.067-inch (1.7-mm) minimum-thickness, cold-rolled, steel or 0.067-inch (1.7-mm) minimum-thickness, metallic-coated, cold-rolled, steel.

H. Exterior Detention Doors: Construct exterior doors to comply with NAAMM-HMMA 863 and as specified.

1. Security Grade 1 or Security Grade 2: Provide doors with face sheets of 0.093-inch (2.3-mm) minimum-thickness, metallic-coated, cold-rolled steel.
2. Security Grade 3 or Security Grade 4: Provide doors with face sheets of 0.067-inch (1.7-mm) minimum-thickness, metallic-coated, cold-rolled steel.

2.5 DETENTION FRAMES

A. General: Provide fully welded detention frames with integral stops, of seamless construction without visible joints or seams. Fabricate detention frames with contact edges closed tight and corners mitered, reinforced, and continuously welded full depth and width of detention frame.

B. Stop Height: Provide minimum stop height of 0.625 inch (16 mm) or 0.750 inch (19 mm) for detention door openings and minimum stop height of 1-1/4 inches (32 mm) in security glazing or detention panel openings.

C. Interior Detention Frames: Construct interior frames to comply with NAAMM-HMMA 863 and as specified.

1. Security Grade 1 or Security Grade 2: Provide frames fabricated from 0.093-inch (2.3-mm) minimum-thickness, cold-rolled steel or 0.093-inch (2.3-mm) minimum-thickness, metallic-coated, cold-rolled steel.
2. Security Grade 3 or Security Grade 4: Provide frames fabricated from 0.067-inch (1.7-mm) minimum-thickness, cold-rolled steel or 0.067-inch (1.7-mm) minimum-thickness, metallic-coated, cold-rolled steel.

D. Exterior Detention Frames: Construct exterior frames to comply with NAAMM-HMMA 863 and as specified.

1. Security Grade 1 or Security Grade 2: Provide frames fabricated from 0.093-inch (2.3-mm) minimum-thickness, metallic-coated, cold-rolled steel.
2. Security Grade 3 or Security Grade 4: Provide frames fabricated from 0.067-inch (1.7-mm) minimum-thickness, metallic-coated, cold-rolled steel.

E. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention frame to comply with the following minimum thicknesses:

1. Hinges and Pivots: 0.187 inch (4.7 mm) thick by 1-1/2 inches (38 mm) wide by 10 inches (254 mm) long.
2. Strikes, Flush Bolts, and Closers: 0.187 inch (4.7 mm) thick.
3. Surface-Mounted Hardware: 0.093 inch (2.3 mm) thick.
4. Lock Pockets: 0.123 inch (3.1 mm) thick at non-inmate side, welded to face sheet. Provide 0.123-inch (3.1-mm) thick, lock protection plate for attachment to lock pocket with security fasteners.

F. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware, interconnected with UL-approved, 1/2-inch (12.7-mm) diameter conduit and connectors.

1. Access Plates: Where indicated for wiring installation, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least four security fasteners spaced not more than 6 inches (152 mm) o.c.

G. Mullions and Transom Bars: Fasten mullions and transom bars at crossings and to jambs by butt welding. Reinforce joints between detention frame members with concealed clip angles or sleeves of same metal and thickness as detention frame.

H. Jamb Anchors: Weld jamb anchors to detention frames near hinges and directly opposite on strike jamb or as required to secure detention frames to adjacent construction.

1. Number of Anchors: Provide two anchors per jamb plus the following:

a. Detention Door Frames: One additional anchor for each 18 inches (457 mm), or fraction thereof, above 54 inches (1372 mm) in height.
b. Detention Frames with Security Glazing or Detention Panels: One additional anchor for each 18 inches (457 mm), or fraction thereof, above 36 inches (914 mm) in height.

I. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material and thickness as detention frame, and as follows:

J. Rubber Door Silencers: Except on weather-stripped detention doors, drill stops in strike jambs to receive three silencers on single-detention-door frames and drill head jamb stop to receive two silencers on double-detention-door frames. Keep holes clear during construction.

K. Grout Guards: Provide factory-installed grout guards of same material as detention frame, welded to detention frame at back of hardware cutouts, silencers, and glazing-stop screw preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.

2.6 DETENTION PANELS

A. Provide fixed detention panels of same materials, construction, and finish as specified for adjoining detention door.

2.7 MOLDINGS AND STOPS

A. Provide fixed moldings on inmate side of glazed openings and removable stops on non-inmate side.

1. Height: As required to provide minimum 1-inch (25-mm) glass engagement, but not less than 1-1/4 inches (32 mm).

2. Fixed Moldings: Formed from same material as detention door and frame face sheets, but not less than 0.093 inch (2.3 mm) thick, and spot welded to face sheets a maximum of 5 inches (127 mm) o.c.
3. Removable Stops: Formed from 0.123-inch (3.1-mm) thick angle, of same material as detention door face sheets. Secure with button head security fasteners spaced uniformly not more than 9 inches (229 mm) or 6 inches (152 mm) o.c. and not more than 2 inches (51 mm) from each corner, and as necessary to satisfy performance requirements. Form corners with notched or mitered hairline joints.

B. Coordinate rabbet width between fixed and removable stops with glass or panel type and installation type indicated.

2.8 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

D. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

E. Concealed Bolts: ASTM A307, Grade A.

F. Masonry Anchors: Same steel sheet as door face.

G. Embedded Anchors: Hot-dip galvanized according to ASTM A153/A153M.

H. Post-Installed Anchors: Torque-controlled expansion anchors.

I. Welding Rods and Bare Electrodes: According to AWS specifications for metal alloy welded.

J. Glazing: Comply with Section 088853 "Security Glazing."

K. Grout: Comply with ASTM C476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C143/C143M.

L. Insulation: Slag-wool-fiber/rock-wool-fiber or glass-fiber blanket insulation.

M. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

N. Waterborne Asphaltic Emulsion Coating: Minimum 2.5-mil (0.06-mm) dry film thickness.

2.9 FABRICATION

A. Fabricate detention doors and frames rigid, neat in appearance, and free of defects, warp, or buckle.

B. Tolerances: Comply with NAAMM-HMMA 863.

C. Removable Jamb Faces: Provide removable jamb faces where required for access to embedded anchors. Fabricate to allow secure reattachment of removable face with security fasteners.

D. Fabricate multiple-opening detention frames with mullions that have closed tubular shapes and with no visible seams or joints.

E. Exterior Detention Doors: Provide weep-hole openings in bottoms of detention doors to permit entrapped moisture to escape. Seal joints in top edges of detention doors against water penetration.

F. Hardware Preparation: Factory prepare detention doors and frames to receive mortised hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final Door Hardware Schedule and templates provided by detention door hardware supplier.

G. Factory cut openings in detention doors.

H. Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

2.10 METALLIC-COATED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mil (0.02 mm).

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10.

2.11 STEEL SHEET FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".

B. Factory Priming for Field-Painted Finish: Apply shop primer immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mil (0.02 mm).

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with SDI A250.10.

2.12 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific fastener type.

1. Drive-System Type: Pinned Torx-Plus or Pinned Torx.

2.13 SEALANTS

A. Security Sealants: Manufacturer's standard, nonsag, tamper-resistant polyurethane or epoxy sealant

2.14 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Embedded Plate Anchors: Mild steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch (12.7-mm) diameter, headed studs welded to back of plate.

C. Welding Rods and Bare Electrodes: According to AWS specifications.

D. Pass-Through Openings: Fabricate flush openings using 0.093-inch (2.3-mm) thick, interior channels of same material as detention door faces, inverted to be flush with openings, welded to inside of both face sheets and with corners fully welded. Mount shutters on non-inmate side of detention doors. Reinforce for locks and food-pass hinges.

1. Inset Shutters: Fabricate from two steel plates, 0.123 inch (3.1 mm) thick, of same material as detention door face sheets, spot welded together and sized to inset inside opening and to prevent inmate tampering of lock and hinges.
2. Overlapping Shutters: For surface application on non-inmate side of door. Fabricate from a single steel plate, of same material as detention door face sheets, 0.187 inch (4.7 mm) thick, sized to overlap food-pass openings by 1/2 inch (12.7 mm).

E. Speaking Apertures: Consist of a rectangular pattern of holes, minimum 1 inch high by 4 inches wide (25 mm high by 102 mm wide), with holes 1/4 inch (6.3 mm) in diameter. Locate holes in both face sheets directly across from each other and spaced not more than 1 inch (25 mm) o.c. vertically and horizontally. Provide 0.067-inch (1.7-mm) thick, pressed-steel baffles in interior of detention door between hole patterns to prevent passage of objects.

F. Gun Ports: Fabricate units to comply with UL 752 and to resist same security level as detention doors in which they are installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation and with shipping spreaders removed, adjust detention frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb and perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of face.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of door rabbet.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

B. Inspect embedded plate installations before installing detention frames to verify that plate installations comply with requirements. Prepare inspection reports.

C. Anchorage: Set detention frame anchorage devices according to details on Shop Drawings and according to anchorage device manufacturer's written instructions.

D. Where detention frames are fabricated in sections due to shipping limitations, assemble frames and install angle splices at each corner, of same material and thickness as detention frame, and extend at least 4 inches (102 mm) on both sides of joint.

1. Field splice only at approved locations. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
2. Continuously weld and finish smooth joints between faces of abutted, multiple-opening, detention frame members.

E. Apply bituminous waterborne asphaltic emulsion coating to backs of frames before filling with grout.

F. Placing Detention Frames: Install detention frames of sizes and profiles indicated. Set detention frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

G. Grout: Fully grout detention frame jambs and heads. Completely fill space between frames and adjacent substrates. Hand trowel grout and take other precautions, including bracing detention frames, to ensure that frames are not deformed or damaged by grout forces.

H. Security Sealant: Apply polyurethane or epoxy security sealant at all exposed gaps between detention frames and adjacent substrates.

I. Swinging Detention Doors: Fit non-fire-rated detention doors accurately in their frames, with the following clearances:

J. Sliding Detention Doors: Fit sliding detention doors in their frames according to manufacturer's written instructions and as required to allow doors to slide without binding.

K. Fire-Rated Detention Doors: Install with clearances as specified in NFPA 80.

L. Smoke-Control Detention Doors: Install according to NFPA 105.

M. Installation Tolerances: Comply with NAAMM-HMMA 863.

N. Glazing: Comply with installation requirements in Section 088853 "Security Glazing" unless otherwise indicated.

O. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors and frames that are warped, bowed, or otherwise unacceptable.

3.2 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Detention work will be considered defective if it does not pass tests and inspections.

C. Prepare field quality-control certification endorsed by Detention Specialist that states installed products comply with requirements in the Contract Documents.

D. Prepare test and inspection reports.

END OF SECTION 083463

SECTION 083473.13 - METAL SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal sound control door assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sound control door assemblies. Include elevations, details, seals, anchorages, and accessories.

C. Samples: For units with factory-applied finishes.

D. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. STC Rating: As indicated on Drawings or as indicated in the Door Schedule as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.

2.2 STEEL SOUND CONTROL DOORS

A. Doors: Flush-design sound control doors, 1-3/4 inches (44 mm) thick, 2 inches (51 mm) thick, 2-1/4 inches (57 mm) thick or thickness as required to provide STC rating, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to NAAMM-HMMA 865.

1. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.048-inch (1.21-mm) nominal thickness or thicker as required to achieve STC rating indicated.
2. Core: Manufacturer's standard sound control core.
3. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
4. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6 inches (152 mm) o.c.
5. Hardware Reinforcement: Same material as face sheets.

B. Glazing: Manufacturers' standard factory-installed glazing. Comply with requirements in Section 088000 "Glazing."

C. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B.
3. Glazing: As required by sound control door assembly manufacturer to comply with sound control requirements.

D. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.

    a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.3 SOUND CONTROL FRAMES

A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.

2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch (1.90-mm) nominal thickness or thicker as required to provide STC rating indicated.
3. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B.
3. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.

    a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.4 HARDWARE

A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC rating indicated.

1. Compression Seals: One-piece units consisting of closed-cell sponge neoprene or silicone seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
3. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed.
4. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
5. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.
6. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum or stainless steel.

B. Other Hardware: Comply with requirements in Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)."

2.5 FABRICATION

A. Steel Sound Control Door Fabrication:

1. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
2. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.
3. Hardware Preparation: Factory prepare sound control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

    a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
    b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

4. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 865.

B. Sound Control Frame Fabrication:

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Anchors: Provide number and spacing of anchors as indicated in NAAMM-HMMA 865.
4. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

    a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
    b. Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

5. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Frames: Install sound control door frames in sizes and profiles indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
    b. Install sound control frames with removable glazing stops located on secure side of opening.
    c. Remove temporary braces only after frames or bucks have been properly set and secured.
    d. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    e. Apply corrosion-resistant coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness as indicated in NAAMM-HMMA 865.

B. Doors: Fit sound control doors accurately in frames, within clearances as indicated in NAAMM-HMMA 865.

C. Sound Control Seals: Where seals have been factory prefit and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

D. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.

E. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 079200 "Joint Sealants."

F. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with sound control door assembly manufacturer's written instructions.

END OF SECTION 083473.13

SECTION 083473.16 - WOOD SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wood sound control door assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For sound control door assemblies. Include elevations, details, seals, anchorages, and accessories.

D. Samples: For units with factory-applied finishes.

E. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE: As directed.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. STC Rating: As indicated on Drawings or as indicated in the Door Schedule as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.

2.2 WOOD SOUND CONTROL DOORS

A. Doors: Flush-design sound control doors, 1-3/4 inches (44 mm) thick, 2 inches (51 mm) thick, 2-1/4 inches (57 mm) thick or thickness as required to provide STC rating; with manufacturer's standard sound-retardant core as required to provide STC rating indicated. Fabricate according to WDMA 1.S.1-A.

B. Glazing: Manufacturers' standard factory-installed glazing. Comply with requirements in Section 088000 "Glazing."

C. Materials: Comply with Section 081416 "Flush Wood Doors" or Section 081433 "Stile and Rail Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements unless otherwise indicated.

D. Finishes:

1. Factory finish sound control wood doors to match doors specified in Section 081416 "Flush Wood Doors" or Section 081433 "Stile and Rail Wood Doors."

2.3 SOUND CONTROL FRAMES

A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.

1. Weld frames according to NAAMM-HMMA 820.
2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch (1.90-mm) nominal thickness or thicker as required to provide STC rating indicated.
3. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B.
3. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.

    a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.4 HARDWARE

A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.

1. Compression Seals: One-piece units consisting of closed-cell sponge neoprene or silicone seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Magnetic Seals: One-piece units consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
3. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
4. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
5. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.
6. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum, stainless steel or solid wood matching wood door faces.

B. Other Hardware: Comply with requirements in Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)."

2.5 FABRICATION

A. Wood Sound Control Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to WDMA I.S.1-A unless otherwise indicated. Comply with final door hardware schedules and hardware templates.

1. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated.
2. Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

    a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.

B. Sound Control Frame Fabrication:

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Anchors: Provide number and spacing of anchors as indicated in NAAMM-HMMA 865.

    a. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

4. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

    a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.

5. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Frames: Install sound control door frames in sizes and profiles indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
    b. Install sound control frames with removable glazing stops located on secure side of opening.
    c. Remove temporary braces only after frames or bucks have been properly set and secured.
    d. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    e. Apply corrosion-resistant coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness to the following tolerances as indicated in NAAMM-HMMA 865.

B. Doors: Fit sound control doors accurately in frames, within clearances as indicated in NAAMM-HMMA 865.

C. Sound Control Seals: Where seals have been factory prefit and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

D. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.

E. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 079200 "Joint Sealants."

F. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with sound control door assembly manufacturer's written instructions.

END OF SECTION 083473.16

SECTION 083483 - FLOOR DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes floor doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated floor doors, list of applicable room name and number in which floor door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 ALUMINUM FLOOR DOORS

A. Gutter Channel Frame Aluminum Floor Door:

1. Frame: Mill finish aluminum, gutter profile, with integral drainage coupling and perimeter gasket.
2. Door: Single or Double leaf; 1/4-inch-thick (6.4-mm-thick), diamond-pattern or smooth mill-finish aluminum plate.
3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load, without impact.
4. Options: Debris gasket or Odor gasket.
5. Hardware:

a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
b. Hinges: Heavy-duty butt hinges with stainless steel pins.
c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
d. Latch: Stainless steel slam latch.
e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, eyed deadbolt lock with threaded protection plug or Hasp and staple.

B. Angle Frame Aluminum Floor Door:

1. Frame: Mill finish aluminum, angle profile.
2. Door: Single or Double leaf; 1/4-inch-thick (6.4-mm-thick), diamond-pattern or smooth mill-finish aluminum plate.
3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load, without impact.
4. Options: Odor gasket.
5. Hardware:

a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
b. Hinges: Heavy-duty butt hinges with stainless steel pins.
c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
d. Latch: Stainless steel slam latch.
e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, keyed deadbolt lock with threaded protection plug, hasp and staple.

C. Safety Accessories: Safety chains, net, railing, telescoping safety post or grid.

2.2 STEEL FLOOR DOORS

A. Gutter Channel Frame Steel Floor Door:

1. Frame: Prime-painted or Hot-dip galvanized steel, gutter profile, with integral drainage coupling and perimeter gasket.
2. Door: Single or Double leaf; manufacturer's standard thickness, 3/16- or 1/4-inch-thick (4.8-mm or 6.4-mm-thick), 3/16-inch-thick (4.8-mm-thick) or 1/4-inch-thick (6.4-mm thick), diamond pattern or smooth; prime-painted or hot-dip galvanized steel plate.
3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load.
4. Options: Debris gasket or Odor gasket.

5. Hardware:

    a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Heavy-duty butt hinges with stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
    d. Latch: Stainless steel slam latch.
    e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, keyed deadbolt lock with threaded protection plug or hasp and staple.

B. Angle Frame Steel Floor Door:

1. Frame: Prime-painted or Hot-dip galvanized steel, angle profile.
2. Door: Single or Double leaf; manufacturer's standard thickness, 3/16- or 1/4-inch-thick (4.8-mm or 6.4-mm-thick), 3/16-inch-thick (4.8-mm-thick) or 1/4-inch-thick (6.4-mm-thick), diamond pattern or smooth; prime-painted or hot-dip galvanized steel plate.
3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load.
4. Options: Debris gasket or Odor gasket.
5. Hardware:

    a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Heavy-duty butt hinges with stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
    d. Latch: Stainless steel slam latch.
    e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, keyed deadbolt lock with threaded protection plug or hasp and staple.

C. Safety Accessories: Safety chains, net, railing, telescoping safety post or grid.

2.3 STAINLESS STEEL FLOOR DOORS

A. Gutter Channel Frame Stainless Steel Floor Door:

1. Frame: Type 304 or Type 316 stainless steel, gutter profile, with integrald rainage coupling and perimeter gasket.
2. Door: Single or Double leaf; manufacturer's standard thickness, 3/16- or 1/4-inch-thick (4.8-mm- or 6.4-mm-thick), 3/16-inch-thick (4.8-mm-thick) or 1/4-inch-thick (6.4-mm-thick), diamond pattern or smooth, Type 304 or Type 316 stainless steel plate.

3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load.
4. Options: Debris gasket or Odor gasket.
5. Hardware:

    a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Heavy-duty butt hinges with stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
    d. Latch: Stainless steel slam latch.
    e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, keyed deadbolt lock with threaded protection plug, hasp and staple.

B. Angle Frame Stainless Steel Floor Door:

1. Frame: Type 304 or Type 316 stainless steel, angle profile.
2. Door: Single or Double leaf; manufacturer's standard thickness, 3/16 or 1/4-inch-thick (4.8-mm or 6.4-mm-thick), 3/16-inch-thick (4.8-mm-thick) or 1/4-inch-thick (6.4-mm-thick), diamond pattern or smooth, Type 304 or Type 316 stainless steel plate.
3. Loading Capacity: 150-lbf/sq. ft. (7.2-kN/sq. m) pedestrian live load, 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load or AASHTO H20 concentrated wheel load.
4. Options: Debris gasket or Odor gasket.
5. Hardware:

    a. Material and Finish: Manufacturer's standard or Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
    b. Hinges: Heavy-duty butt hinges with stainless steel pins.
    c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
    d. Latch: Stainless steel slam latch.
    e. Lock: Latch with removable handle, recessed padlock hasp, recessed padlock hasp with cover, keyed deadbolt lock, keyed deadbolt lock with threaded protection plug or hasp and staple.

C. Safety Accessories: Safety chains, net, railing, telescoping safety post or grid.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

E. Rolled-Stainless Steel Floor Plate: ASTM A793, manufacturer's standard finish.

F. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.

G. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

H. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

I. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

J. Frame Anchors: Same material as door face.

K. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. General: Provide floor doors manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure floor doors to types of supports indicated.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that comes in contact with concrete.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

E. Prime Painted Steel: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

F. Stainless Steel Finish: Bright, cold-rolled, unpolished ASTM A480/A480M No. 2B finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing floor doors.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage or engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated floor door in accordance with NFPA 80, section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated floor door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083483

SECTION 083513 - FOLDING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Accordion folding doors.
2. Panel folding doors.
3. Metal bifold doors.
4. Mirrored metal bifold doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE: As directed.

PART 2 - PRODUCTS

2.1 ACCORDION FOLDING DOORS

A. Description: Top-supported, horizontal-sliding, manually operated accordion folding doors, with chain controlling the spacing and extension of pantographic or X-type accordion folding frames.

B. Covers: Attached to accordion folding frames with concealed fasteners that allow on-site cover removal and repair.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or 450 or less.

2. Vinyl Cover Material: Reinforced with woven backing weighing not less than 20 oz./linear yd. (567 g/m).

    a. Color, Texture, and Pattern: As indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.

3. Fabric Cover Material: Weighing not less than 6.7 oz./linear yd. (208 g/m) or 12 oz./linear yd. (372 g/m), treated to resist stains.

    a. Color, Texture, and Pattern: As indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.

4. Carpet Cover Material: Manufacturer's standard nonwoven carpet, needle punched with fused fibers to prevent unraveling.

    a. Color, Texture, and Pattern: As indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.

C. Sweep Seals: Located at top and bottom on both sides or one side of door.

D. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing. Wheels are ball-bearing type and equipped with nylon tread and steel shafts.

E. Tracks: Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Provide the following features:

1. Recessed or Surface mounting.
2. Ceiling guard.
3. Center stop for center-opening doors.
4. Curved track sections.

F. Hardware:

1. Finish: Clear-anodized aluminum, Satin stainless steel, Dull chromium-finish brass, Dull chromium-finish steel or manufacturer's standard.
2. Latch: Operable from both sides or one side of closed door with coin-slot release on opposite side.
3. Lock: Manufacturer's standard key-operated cylinder lock, operable from both sides, Manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side, Deadlock to receive cylinder, operable from both sides. See Section 087100 "Door Hardware" for cylinder requirements or Deadlock to receive cylinder, operable from both sides. See Section 087111 "Door Hardware (Descriptive Specification)" for cylinder requirements.
4. Foot Bolts: On lead post where indicated.

G. Jamb Molding: At closing jamb as required for light-tight jamb closure.

1. Jamb Strip: Nonferrous for end-opening doors.

H. Posts:

1. Fixed Jamb Post: To anchor door to stack jamb.
2. Rolling Jamb Post: To allow door to disconnect from stack jamb.
3. Sliding Jamb: To allow door to stack in storage pocket.
4. Lead Post: At closing edge of door.

I. Tiebacks: To maintain door in stacked position.

2.2 PANEL FOLDING DOORS

A. Description: Top-supported, horizontal-sliding, manually operated panel folding doors, with panels joined by continuous hinge connectors for the full height of panels.

B. Nominal Panel Width: 4 inches (100 mm), 5 inches (125 mm), 6 inches (150 mm) or 8 inches (200 mm).

C. Panel Facing:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or 450 or less.

2. Vinyl Facing: In color and texture indicated by manufacturer's designation, matching Architect's sample or selected by Architect from manufacturer's full range.
3. Vinyl Facing with Woven Backing: In color and texture indicated by manufacturer's designation, matching Architect's sample or selected by Architect from manufacturer's full range.
4. Plastic-Laminate Facing: Grade VGS, high-pressure plastic laminate complying with NEMA LD 3.

    a. Color, Texture, and Pattern: As indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.

5. Wood-Veneer Facing: Wood veneer, with manufacturer's standard clear or stained transparent finish, as directed.

    a. Stain Color: As indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.

D. Carriers: Four-wheel carriers at lead post and two-wheel carriers at intermediate spacing.

E. Tracks: Limit track deflection, independent of structural supporting system, to no more than 80 percent of bottom clearance. Provide the following features:

1. Recessed or Surface mounting.
2. Ceiling guard.
3. Center stop for center-opening doors.
4. Curved track sections.

F. Hinge Connector: In color indicated by manufacturer's designation, matching Architect's sample, selected by Architect from manufacturer's full range or matching or coordinating with facing color.

G. Hardware:

1. Finish: Clear-anodized aluminum, Satin stainless steel, Dull chromium-finish brass, Dull chromium-finish steel or manufacturer's standard.
2. Latch: Operable from both sides or one side of closed door.
3. Lock: Manufacturer's standard key-operated cylinder lock, operable from both sides, manufacturer's standard key-operated cylinder lock, operable from one side; privacy lock on other side, Deadlock to receive cylinder, operable from both sides. See Section 087100 "Door Hardware" for cylinder requirements or Deadlock to receive cylinder, operable from both sides. See Section 087111 "Door Hardware (Descriptive Specification)" for cylinder requirements.
4. Foot Bolts: On lead post where indicated. Secure to post to avoid interference with seals.

H. Jamb Molding: At closing jamb for light-tight jamb closure.

1. Material: Wood, matching species and finish of panel facing or Metal, in manufacturer's standard finish.
2. Jamb Strip: Nonferrous for end-opening doors.

I. Wood Track Molding: To match species and finish of panel facings.

J. Jambs and Posts:

1. Fixed Jambs: For doors anchors anchored to stack jamb.
2. Double End Posts: To allow door to operate from both ends.
3. Rolling Jamb Post: To allow door to disconnect from stack jamb.
4. Sliding Jamb: To allow door to stack in storage pocket.
5. Lead Post: At closing edge of door.

K. Tiebacks: To maintain door in stacked position.

2.3 METAL BIFOLD DOORS

A. Description: Metal folding doors hinged together in pairs and supported on pivots at jamb, overhead track, and door guide pins.

B. Metal Panels: Formed from nominal 0.024-inch (0.6-mm) thick, cold-rolled steel sheet.

1. Surface Profile: As indicated on Drawings, fully louvered, Flush, Paneled or Louvered and paneled.
2. Sheet Metal Texture: Smooth or Simulated leather.
3. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
4. Baked-Enamel Finish: Electrostatically applied, baked-on factory finish in white, ivory or custom color as selected by Architect.

C. Hardware:

1. Hinges: Three self-aligning hinges per pair of doors.
2. Guides and Pivots: Not less than 9/16-inch (14-mm) diameter, adjustable screw-type, weight-bearing, zinc-plated pivot rod held in place by nylon rod clamp assemblies; with not less than 1/4-inch (6.4-mm) diameter, spring-loaded, self-aligning, zinc-plated steel guide rods and top pivot rods held in place by nylon sleeves.
3. Overhead Track: Extruded aluminum, 0.05 inch (1.3 mm) thick, in mill finish.
4. Floor Guide: Extruded-aluminum track matching top track that retains bottom guide pin(s) or mill-finish aluminum floor-mounted bracket retains bottom pivot; provide aligning bracket at leading edges of door pairs for four-panel doors.

2.4 MIRRORED BIFOLD DOORS

A. Description: Mirrored folding doors hinged together in pairs and supported on pivots at jamb, with floor and overhead track and door guide pins.

B. Steel-Panel Door Construction: Flush profile, formed from nominal 0.024-inch (0.6-mm) thick, cold-rolled steel sheet. Attach mirrored glass facing to steel sheet dual-faced cushion tape. Protect bottom edge of mirror with steel channel.

1. Mirrored-Glass Edging: Mylar to match track and hardware finish.
2. Protective Finish: Hot-dip galvanized coating applied to panels, stiffeners, hinges, and decorative trim.
3. Baked-Enamel Finish: Electrostatically applied, baked-on factory finish in white, ivory, black or custom color as selected by Architect.
4. Overhead Track: Extruded aluminum; 0.05 inch (1.3 mm) thick; mill or chrome finish.
5. Floor Guide: Extruded-aluminum track matching top track that retains bottom guide pin(s) or mill-finish aluminum floor-mounted bracket retains bottom pivot; provide aligning bracket at leading edges of door pairs for four-panel doors.

C. Metal-Framed Door Construction: Aluminum or Steel stiles and mechanically fitted rails with screw-attached stiffeners and with mirrored-glass facing attached securely to frames.

1. Panel Style: Exposed frame or Concealed frame; mirrored glass with polished vertical edges.
2. Steel, Enamel Finish: Electrostatically applied, baked-on factory finish in white, off white, brown, black or custom color as selected by Architect.
3. Steel, Metallic Finish: Chrome, Satin gold, Bright gold or as selected by Architect from manufacturer's full range.
4. Anodized Aluminum Finish: Satin brass, Bright brass, Satin chrome or Bright chrome.
5. Track: Overhead and bottom track prefinished to match door.

D. Mirrored Glass: 3-mm thick, silvered, mirrored, film-backed safety glass, complying with 16 CFR 1201 for Category II safety glass and with ASTM C1036 for Type I (transparent, flat), Class 1(clear), Quality q2 (mirror) annealed float glass.

E. Hardware:

1. Hinges: Three self-aligning concealed hinges.

2. Guides and Pivots: Spring-loaded, zinc-plated steel guides and tops, and adjustable bottom pivot pins with nylon bushings and tips.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install folding doors complying with manufacturer's written installation instructions. Install track in one piece.

B. Standard Floor Clearances: 1/4 to ¾- inch (6.4 to 19 mm) maximum (above floor finish).

END OF SECTION 083513

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manually or electrically operated sectional doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two or Five years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings or Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
2. Testing: According to ASTM E330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.

C. Windborne-Debris Impact Resistance: Provide glazed sectional doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1, ASTM E1996 for Wind Zone 2, ASTM E1996 for Wind Zone 3, ASTM E1996 for Wind Zone 4 or DASMA 115 for basic or enhanced protection.

1. Large-Missile Test: For sectional doors located within 30 feet (9.1 m) of grade.

D. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

A. Steel, Wood, Aluminum, Full-Vision Aluminum or Translucent Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000, 20,000, 50,000 or 100,000.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283 or DASMA 105.

D. Installed R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W), 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W), 12.0 deg F x h x sq. ft./Btu (2.113 K x sq. m/W), 15.0 deg F x h x sq. ft./Btu (2.642 K x sq. m/W) or 17.5 deg F x h x sq. ft./Btu (3.082 K x sq. m/W).

E. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 (Z180) or G90 (Z275) zinc coating.

1. Section Thickness: 1-3/8 inches (35 mm), 1-3/4 inches (44 mm) or 2 inches (51 mm).
2. Exterior-Face Surface: Flat, Grooved, Ribbed, Paneled or Wood-grain embossed.
3. Interior Facing Material: Zinc-coated (galvanized) steel sheet, hardboard panel wood or manufacturer's standard material.

F. Wood Sections: Paneled or Flush.

G. Aluminum Sections: Solid panels, Full vision or with manufacturer's standard, nonglazed panels across bottom section of door.

H. Translucent Sections: Manufacturer's standard with manufacturer's standard, nonglazed panels across bottom section of door.

I. Track Configuration: Standard-lift, Low-headroom, High-lift, Vertical-lift or Contour track.

J. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.

K. Windows: Approximately 24 by 7 inches (610 by 178 mm) or 24 by 11 inches (610 by 279 mm), with curved corners or with square corners, and spaced apart the approximate distance as indicated on Drawings; in one or two row(s) at height indicated on Drawings; installed with insulated glazing of clear float glass, clear acrylic plastic or clear polycarbonate plastic.

L. Locking Devices: Equip door with slide bolt for padlock or locking device assembly and chain lock keeper.

1. Locking Device Assembly: Single-jamb side, Cremone type, both jamb sides, locking bars, operable from inside with thumbturn, outside with cylinder, outside only, with cylinder or inside and outside, with cylinders.

M. Manual Door Operator: Push-up operation or Chain-hoist operator.

N. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day, Standard duty, up to 25 cycles per hour and up to 90 cycles per day, Medium duty, up to 12 cycles per hour and up to 50 cycles per day or Light duty, up to 10 cycles per hour.
2. Operator Type: Manufacturer's standard for door requirements, Trolley, Jackshaft, center mounted, Jackshaft, side mounted or as indicated on Drawings.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
4. Motor Exposure: Interior, clean, and dry or Exterior, dusty, wet, or humid.
5. Emergency Manual Operation: Push-up or Chain type.
6. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom section or self-monitoring type.

7. Control Station: Interior-side mounted, Exterior-side mounted, where indicated on Drawings.
8. Other Equipment: Audible and visual signals or Portable, radio-control system.

O. Door Finish:

1. Aluminum Finish: Clear anodized, Bronze anodized, Anodized color matching Architect's sample or Anodized color as selected by Architect from manufacturer's full range.
2. Baked-Enamel or Powder-Coat Finish: Color and gloss as indicated by manufacturer's designations, Color and gloss matching Architect's sample or Color and gloss as selected by Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Finish of Interior Facing Material: Match finish of exterior section face, Finish as indicated by manufacturer's designations, Finish matching Architect's sample or Finish as selected by Architect from manufacturer's full range.

2.3 STEEL DOOR SECTIONS

A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet.

1. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet welded to door section. Provide intermediate stiles formed from galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches (1219 mm) apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

E. Provide reinforcement for hardware attachment.

F. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

2.4 WOOD DOOR SECTIONS

A. Paneled Sections: Stiles and rails of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce, not less than 1-3/4 inches (44 mm) thick. Form meeting rails to provide rabbeted, weather-resistant seal.

1. Panel Inserts: Tempered hardboard, 1/4 inch (6 mm) thick, smooth on two sides.
2. Glazed Panel Inserts: 6-mm-thick, clear float glass, with removable glazing stops of same wood as stiles and rails.

B. Flush Sections: Construct flush wood door sections with top, bottom, and end closures of clear, vertical-grain, straight, kiln-dried Douglas fir, West Coast hemlock, or Sitka spruce. Provide wood blocking to receive hardware, end stiles, and frames for glazing, glued and doweled in place. Form meeting rails to provide rabbeted weather-resistant seal.

1. Core: Manufacturer's standard polystyrene or polyurethane board insulation or honeycomb core complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Bond to facing.
2. Exterior Facing Material: 1/8-inch (3-mm) thick, tempered hardboard, smooth on one side.
3. Interior Facing Material: Wood, Hardboard panel or manufacturer's standard material.

C. Reinforce sections with continuous horizontal and diagonal galvanized-steel members as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.

D. Treat wood door members after machining with water-repellent preservative formulation according to WDMA I.S. 4.

E. Factory prime door sections with one coat of exterior primer compatible with field-applied finish.

2.5 ALUMINUM DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.

1. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
2. Provide reinforcement for hardware attachment.

B. Solid Panels: Aluminum sheet, set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop.

C. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.6 TRANSLUCENT DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; and with overlapped or interlocked weather-resistant seal at meeting rails.

1. Reinforce or form trusses within sections as required to stiffen door and for wind loading.
2. Provide reinforcement for hardware attachment.

B. Translucent Panels: Ribbed, translucent, glass-fiber-reinforced plastic panels, secured and sealed watertight to framing, and reinforced to comply with performance requirements.

2.7 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

C. Windows: Manufacturer's standard window units of type, size, and in arrangement indicated. Provide removable stops of same material as door-section frames.

2.8 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Provide 3-inch (76-mm) diameter roller tires for 3-inch (76-mm) wide track and 2-inch (51-mm) diameter roller tires for 2-inch (51-mm) wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

2.9 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware", specified in Section 087111 "Door Hardware (Descriptive Specification)", standard with manufacturer and keyed to building keying system.
2. Keys: Two or Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.10 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229/A229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.

C. Cables: Galvanized-steel, multistrand, lifting cables.

D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.11 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) or 35-lbf (155-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.12 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

a. Phase: Single phase or Polyphase.
b. Volts: 115, 208, 230 or 460 V.
c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.

E. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.

F. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

G. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N) or 35 lbf (155 N).

H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

K. Portable, Radio-Control System: Consisting of one or two of the following:

1. Three-channel universal coaxial receiver to open, close, and stop door.
2. Portable control device to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks: Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

E. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

F. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storefront framing.
2. Manual-swing entrance doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

D. Samples: For each type of exposed finish required.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite, 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not show evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

   a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2. Entrance Doors:

   a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K), 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) or 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.26, 0.35, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 15, 25, 35, 45, 55, 65 or 75 as determined according to NFRC 500.

I. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STOREFRONT SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken, Thermally improved or Nonthermal.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Finish: Clear anodic finish, Color anodic finish, Baked-enamel or powder-coat finish or High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm), 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm- or 2 to 2-1/4-inch (50.8 to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

   a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated, Narrow stile; 2-1/8-inch (54-mm) nominal width, Medium stile; 3-1/2-inch (88.9-mm) nominal width or Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Beveled or Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)".

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule or entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products, products equivalent in function and comparable in quality to named products or products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Cylinders: As specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)".

E. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

F. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin or Nonferrous.
3. Quantities:

    a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
    b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.

G. Continuous-Gear Hinges: BHMA A156.26.

H. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

I. Manual Flush Bolts: BHMA A156.16, Grade 1.

J. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

K. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

L. Cylinders: BHMA A156.5, Grade 1.

1. Keying: No master or Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" or to be furnished by Owner, as directed.

M. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

N. Operating Trim: BHMA A156.6.

O. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

P. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

Q. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

R. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

S. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

T. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

U. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

V. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior, interior or interior for vision glass and exterior for spandrel glazing or metal panels.

6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts or mockups, as directed.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two or three tests in areas as directed by Architect.

2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

    a. Perform a minimum of two or three tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa) and shall not show evidence of water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ENTRANCE DOOR HARDWARE SETS

END OF SECTION 084113

SECTION 084126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior, Exterior or Interior and exterior swinging all-glass entrance doors.
2. All-glass sidelights and transoms.
3. Interior and exterior all-glass storefronts.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For all-glass entrances and storefronts.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of patch fittings and rail fittings.
3. Door hardware locations, mounting heights, and installation requirements.

D. Samples: For each type of exposed finish indicated.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion, except as follows:

a. Concealed Floor Closers: Five, 10 or 25 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: Deflection normal to glazing plane is limited to 1 inch (25 mm) or 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.

C. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

A. As directed.

2.3 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Doors Sidelights and Transoms: Patch fittings at head and sill on pivot side only, Patch fittings at head and sill on pivot side, and for lock

at sill of swing side, Patch fitting at top and continuous rail fitting at bottom or Continuous rail fitting at top and bottom.

2. All-Glass Storefronts: Recessed glazing channel at top and continuous rail fitting at bottom, Recessed glazing channel at top and bottom or Continuous rail fitting at top and bottom.

B. Patch Fittings: Aluminum, Bronze-clad aluminum, Brass-clad aluminum or Stainless-steel-clad aluminum.

C. Rail Fittings:

1. Material: Match patch-fitting metal and finish, Aluminum, Bronze-clad aluminum, Brass-clad aluminum or Stainless-steel-clad aluminum.
2. Height:

    a. Top Rail: 3-1/2 inches (89 mm) or as indicated.
    b. Bottom Rail: 3-1/2 inches (89 mm), 10 inches (255 mm) or as indicated.

3. Profile: Tapered, Tapered flat, Tapered at 60 degrees minimum from the horizontal, Square, Curveds indicated.
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Accessory Fittings: Match patch-fitting, rail-fitting or patch and rail-fitting metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.

E. Anchors and Fastenings: Concealed.

F. Weather Stripping: Pile type; replaceable without removing all-glass entrance doors from pivots.

G. Materials:

1. Aluminum: ASTM B221 (ASTM B221M), with strength and durability characteristics of not less than Alloy 6063-T5.

    a. Color: Light bronze, Medium bronze, Dark bronze, Black, Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2. Bronze Cladding: ASTM B36/B36M, alloy as standard with manufacture.

    a. Finish: Mirror polish, Satin polish, Satin oxidized oil rub, Clear baked enamel, match Architect's sample or as selected by Architect from full range of industry finishes.

3. Brass Cladding: ASTM B36/B36M, alloy as standard with manufacturer.

    a. Finish: Polished, Satin or as selected by Architect from full range of industry finishes.

4. Stainless-Steel Cladding: ASTM A666, Type 304.

    a. Finish: No. 4 directional satin finish or No. 8 mirrorlike reflective, nondirectional polish.

2.4 GLASS

A. Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

    a. Thickness: 3/8 inch (10 mm), 1/2 inch (13 mm), 5/8 inch (16 mm) or 3/4 inch (19 mm).
    b. Locations: As indicated.

2. Class 2: Tinted monolithic.

    a. Color: Gray or Bronze.
    b. Thickness: 3/8 inch (10 mm) or 1/2 inch (13 mm).
    c. Locations: As indicated.
    d. Visible Light Transmittance: Percent minimum, as directed.
    e. Solar Heat Gain Coefficient: Maximum, as directed.
    f. Outdoor Visible Reflectance: Percent maximum, as directed.

3. Exposed Edges: Machine ground and flat polished.
4. Butt Edges: Flat ground.
5. Corner Edges: Lap-joint corners with exposed edges polished.

2.5 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings.

B. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.

1. Swing: Single or Double acting.

    a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.

2. Hold Open: Automatic, at angle selected, Selective or None, as directed.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.

b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.

D. Push-Pull Set: As selected from manufacturer's full range or as indicated.

E. Single-Door and Active-Leaf Locksets: Center-housing deadbolt with pulls, Center-housing combination deadbolt and latchbolt with lever handles or Bottom-fitting or bottom-rail deadbolt.

1. Deadbolt operated by key outside and key or thumb turn inside.

F. Inactive-Leaf Locksets: Bottom-fitting or bottom-rail deadbolt.

1. Deadbolt operated by key outside and key or thumb turn inside.

G. Cylinders: As specified in Section 087100 "Door Hardware", as specified in Section 087111 "Door Hardware (Descriptive Specification)" or Six-pin cylinder, BHMA A156.5, Grade 1.

H. Exit Devices: UL 305.

1. Function: Operation by push-pull when inside operator is locked down (dogged) or inside operator is locked down (dogged); outside operation by key.
2. Latching: At threshold or floor plate, door head or threshold or floor plate and door head.
3. Style: Exposed vertical rod or Concealed vertical rod in housing style indicated.
4. Provide exit devices on both leaves of pairs of doors.

I. Threshold: Not more than 1/2 inch (13 mm) high.

2.6 BUTT-GLAZING SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Uses NT, G, and A.

2.7 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

END OF SECTION 084126

SECTION 084213 - ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual-swing entrance doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

D. Samples: For each type of exposed finish required.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

C. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, entrance doors do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, entrance doors, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Entrance Doors:

a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

E. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas of entrance doors when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

F. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K), 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) or 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have a SHGC of no greater than 0.26, 0.35, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 15, 25, 35, 45, 55, 65 or 75 as determined according to NFRC 500.

G. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1, Wind Zone 2, Wind Zone 3 or Wind Zone 4.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm-, 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch (4.8-mm) or 2- to 2-1/4-inch (50.8 to 57.2-mm) overall thickness, with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated, Narrow stile; 2-1/8-inch (54-mm) nominal width, Medium stile; 3-1/2-inch (88.9-mm) nominal width or Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Beveled or Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: 1-3/4 by 4-1/2 inches (45 by 115 mm), 1-3/4 by 6 inches (45 by 150 mm) or as indicated on Drawings.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

    a. Sheet and Plate: ASTM B209 (ASTM B209M).
    b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
    c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
    d. Structural Profiles: ASTM B308/B308M.

2. Steel Reinforcement:

    a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
    b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
    c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
    d. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)".

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule or entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products, products equivalent in function and comparable in quality to named products or products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Cylinders: As specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

E. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

F. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin or Nonferrous.
3. Quantities:

    a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
    b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.

G. Continuous-Gear Hinges: BHMA A156.26.

H. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

I. Manual Flush Bolts: BHMA A156.16, Grade 1.

J. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

K. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

L. Cylinders: BHMA A156.5, Grade 1.

1. Keying: No master or Master] key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" or to be furnished by Owner, as directed.

M. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

N. Operating Trim: BHMA A156.6.

O. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

P. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

Q. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

R. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

S. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

T. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

U. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

V. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in both color coat and clear topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on aluminum-framed entrances.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa) and shall not evidence water penetration.

C. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ENTRANCE DOOR HARDWARE SETS

END OF SECTION 084213

SECTION 084226 - ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual-swinging, all-glass entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For all-glass entrances.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of fittings.
3. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Initial Selection: For each type of exposed finish indicated.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Delegated-Design Submittal: For all-glass entrance systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of all-glass entrance systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion for assembly and components unless otherwise indicated.

a. Concealed Floor Closers: Five, 10 or 25 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design all-glass entrance systems.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrance systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: Deflection normal to glazing plane is limited to 1 inch (25 mm) or 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller.

D. Seismic Performance: All-glass entrance systems shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUAL-SWINGING, ALL-GLASS ENTRANCES

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Door Systems: Patch fittings at head and sill on pivot side only (A-Style), Patch fittings at head and sill on pivot side, and for lock at sill of swing side (F-Style), Patch fitting at top and continuous rail fitting at bottom (BP-Style) or Continuous rail fitting at top and bottom (P-Style).

B. Fitting Material: Aluminum, Bronze-clad aluminum, Brass-clad aluminum or Stainless steel-clad aluminum.

C. Rail Fittings:

1. Height:

a. Top Rail: 3-1/2 inches (89 mm) or as indicated.
b. Bottom Rail: 3-1/2 inches (89 mm), 10 inches (255 mm) or as indicated.

2. Profile: Tapered, Tapered flat, Tapered at 60 degrees minimum from the horizontal, Square, Curved or as indicated.
3. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

D. Accessory Fittings:

1. Overhead doorstop.
2. Center-housing lock.
3. U-channel.
4. Glass-support-fin brackets.

E. Anchors and Fastenings: Concealed.

F. Weather Stripping: Pile type; replaceable without removing all-glass entrance doors from pivots.

G. Door Hardware: Entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of fittings.

1. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.
2. Swing: Single or Double acting, as directed.

a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.

3. Hold Open: Automatic, at angle selected, Selective or None, as directed.
4. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior (Swinging) Doors: Not more than 5 lbf (22.2 N) to fully open door.

5. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.
6. Push-Pull Set: As selected from manufacturer's full range or as indicated.
7. Single-Door and Active-Leaf Locksets: Center-housing deadbolt with pulls, Center-housing combination deadbolt and latchbolt with lever handles or Bottom-fitting or bottom-rail deadbolt.
8. Deadbolt operated by key outside and key or thumb turn inside.
9. Inactive-Leaf Locksets: Bottom-fitting or bottom-rail deadbolt.

a. Deadbolt operated by key outside and key or thumb turn inside.

10. Cylinders: As specified in Section 087100 "Door Hardware", as specified in Section 087111 "Door Hardware (Descriptive Specification)" or Six-pin cylinder, BHMA A156.5, Grade 1, as directed.
11. Exit Devices: UL 305.

a. Function: Operation by push-pull when inside operator is locked down (dogged) or inside operator is locked down (dogged); outside operation by key.
b. Latching: At threshold or floor plate, door head or threshold or floor plate and door head.
c. Style: Exposed vertical rod or Concealed vertical rod in housing style indicated, as directed.
d. Provide exit devices on both leaves of pairs of doors.

12. Threshold: Not more than 1/2 inch (13 mm) high.

2.3 GLASS

A. Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Quality-Q3, tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 3/8 inch (10 mm), 1/2 inch (13 mm), 5/8 inch (16 mm) or 3/4 inch (19 mm), as directed.
b. Locations: As indicated.

2. Class 2: Tinted monolithic.

a. Color: Gray or Bronze.
b. Thickness: 3/8 inch (10 mm) or 1/2 inch (13 mm).
c. Locations: As indicated.

d. Visible Light Transmittance: Percent minimum, as directed.
e. Solar Heat Gain Coefficient: Maximum, as directed.
f. Outdoor Visible Reflectance: Percent maximum, as directed.

3. Exposed Edges: Machine ground and flat polished.
4. Butt Edges: Flat ground.
5. Corner Edges: Lap-joint corners with exposed edges polished.

2.4 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), with strength and durability characteristics of not less than Alloy 6063-T5.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
3. Color: Light bronze, Medium bronze, Dark bronze, Black], Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

B. Bronze Cladding: ASTM B36/B36M, alloy as standard with manufacturer.

1. Finish: Polished M21-O6x, Satin M31-M34-O6x, Statuary M31-C5, match Architect's sample or as selected by Architect from full range of industry finishes.

C. Brass Cladding: ASTM B36/B36M, alloy as standard with manufacturer.

1. Finish: Polished M21-O6x, Satin M31-M34-O6x or as selected by Architect from full range of industry finishes.

D. Stainless Steel Cladding: ASTM A666, Type 304.

1. Finish: No. 4 directional satin finish or No. 8 mirrorlike reflective, nondirectional polish.

2.5 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 INSTALLATION OF MANUAL-SWINGING, ALL-GLASS ENTRANCES

A. Install all-glass entrance systems and associated components in accordance with manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts in accordance with manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

END OF SECTION 084226

SECTION 084229.13 - FOLDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exterior and interior, folding, power-operated automatic entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For folding automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Indicate locations of activation and safety devices.
4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For automatic entrances.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.

B. Certified Inspector Qualifications: Certified by AAADM.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Seismic Loads: As directed.
2. Wind Loads: As directed.

C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. (6.4 L/s x sq. m) of fixed entrance-system area when tested according to ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2.3 FOLDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances, including doors, framing, headers, overhead tracks, door operators, controls, and accessories required for a complete installation.

B. Folding, Power-Operated Automatic Entrance:

1. Configuration: One pair of folding doors that fold to one side or Two pairs of folding doors (biparting) that fold to each side of door opening with transom.

   a. Traffic Pattern: One or Two way.
   b. Mounting: Between jambs or Surface.

2. Operator Features:

   a. Power opening and spring or power closing.
   b. Adjustable opening and closing speeds.
   c. Adjustable hold-open time between zero and 30 seconds.
   d. Obstruction recycle.
   e. Automatic door re-open if stopped while closing.
   f. On-off/hold-open switch to control electric power to operator, key operated.

3. Folding-Door Overhead Tracks: Assembly consisting of guide-track and breakaway system; secured to header. Connect one folding leaf at the top to door operator and set on a floor-mounted bottom pivot; no bottom track is permitted.
4. Controls: Activation and safety devices as indicated on Drawings and according to BHMA standards.

a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
b. Activation Device: Push-plate switch or on each side of door to activate door operator.
c. Safety Device: Presence sensor mounted on door header, horizontal door muntin or guide rail to detect pedestrians in presence zone and to prevent door from closing.

5. Finish: Finish framing, door(s), and header with Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, baked-enamel or powder-coat finish, high-performance organic finish (two-coat fluoropolymer), high-performance organic finish (three-coat fluoropolymer), finish matching adjacent curtain wall or finish matching adjacent storefront.

    a. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: As indicated on Drawings, 1-3/4 by 4-1/2 inches (45 by 115 mm) or 1-3/4 by 6 inches (45 by 150 mm).
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch (1.6-mm) wall thickness.

B. Stile and Rail Doors: 1-3/4-inch (45-mm) thick, glazed doors with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
2. Stile Design: As indicated on Drawings or Narrow stile, 2-1/8-inch (55-mm) nominal width.
3. Rail Design: As indicated on Drawings, 5-inch (125-mm) nominal height, 6-1/2-inch (165-mm) nominal height or 10-inch (254-mm) nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

C. Transom: 1-3/4-inch (45-mm) deep with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.

D. Headers: Fabricated from minimum 0.125-inch (3.2-mm) thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Surface mounted or Concealed, with one side of header flush with framing.

E. Signage: As required by cited BHMA standard.

1. Application Process: Decals, Silk-screened or Door manufacturer's standard process.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221 (ASTM B221M).
2. Sheet: ASTM B209 (ASTM B209M).

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Stainless-Steel Bars: ASTM A276/A276M or ASTM A666, type 304 or type 316.

D. Stainless-Steel Tubing: ASTM A554, Grade MT 304 or Grade MT 316.

E. Expanded Aluminum Mesh: Expanded or Expanded and flattened aluminum sheet according to the geometry of ASTM F1267.

F. Polycarbonate Sheet: ASTM C1349, Appendix X1, type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.

G. Glazing: As specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

I. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

J. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled

mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bi- and unidirectional detection.
2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Round or Square push plate with 4-by-4-inch (100-by-100-mm) junction box.

   a. Mounting: As indicated on Drawings, Recess mounted, semi-flush in wall or Surface mounted on wall.

2. Configuration: Rectangular push plate with 2-by-4-inch (50-by-100-mm) junction box.

   a. Mounting: As indicated on Drawings, Recess mounted, semi-flush in wall, Recess mounted in door jamb, Surface mounted on wall, Surface mounted on post or Surface mounted on guide rail.

3. Push-Plate Material: Stainless steel or Plastic, as selected by Architect from manufacturer's full range.
4. Message: Plain face with no message, "Push to Open", International symbol of accessibility or International symbol of accessibility and "Push to Open."

F. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Interrupt powered operation of door operator while in breakaway mode.

C. Hinges:

1. Center-Pivot Sets: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
2. Offset Pivots: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.

D. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch (25-mm) long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type, as specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

    a. Keying: No master or Integrate into building master key system.
    b. Keys: Two or Three for each cylinder.

2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
3. Two-Point Locking for Single-Folding Doors: BHMA A156.5, Grade 1, mortise-type, laminated-steel hookbolt mounted in stile of active door panel that engages strike jamb when operated by cylinder; and with concealed, vertical flush bolt mounted in hinge stile that engages header when operated by cylinder.
4. Two-Point Locking for Biparting-Folding Doors: BHMA A156.5, Grade 1, mortise-type, laminated-steel hookbolt mounted in stile of active door panel that engages active panel of opposite door when operated by cylinder; and with concealed, vertical flush bolts mounted in each hinge stile that engage header when operated by cylinders.

E. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of 1/2 inch (13 mm). Provide cutouts as required for door operating hardware.

F. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
2. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
3. Weather Sweeps: Nylon brush sweep mounted to underside of door bottom.

G. Finger Guards: Collapsible neoprene or PVC gasket.

2.8 ACCESSORIES

A. Guide Rails: Anodized aluminum, Baked-enamel or powder-coated aluminum or Stainless steel, fabricated from bars or tubing, minimum 30 inches (762 mm) high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than that required by BHMA A156.10 for type of door and direction of travel; with filler panel.

1. Filler Panel: Expanded aluminum mesh, Clear polycarbonate sheet or Colored polycarbonate sheet.

    a. Orient expanded aluminum mesh with long dimension of diamonds parallel to top rail or perpendicular to top rail.
    b. Color: Match Architect's sample or as selected by Architect from manufacturer's full range.

2. Mounting: As indicated on Drawings, Jamb and floor or Floor, freestanding.
3. Aluminum Finish: Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, Baked-enamel or powder-coat finish or Finish matching door and frame.

    a. Color: Light bronze, Medium bronze, Dark bronze, Black, Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

4. Stainless-Steel Finish: No. 4 directional-satin-finish stainless steel or Finish matching door and frame.

B. Guide Rails: See Section 055213 "Pipe and Tube Railings" or Section 057300 "Decorative Metal Railings."

2.9 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Provide components with concealed fasteners and anchor and connection devices.
2. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
3. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
5. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors.
2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.

4. Provide finger guards at each folding-door panel that has clearance at hinge side greater than 1/4 inch (6 mm) and less than 3/4 inch (19 mm) with door in any position. Anchor guards to hinge-jamb frame.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide thresholds at exterior doors and where indicated.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system, as specified in Section 281300 "Access Control Software and Database Management."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door, as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage or engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.13

SECTION 084229.23 - SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exterior and interior, sliding, power-operated automatic entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For sliding automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Indicate locations of activation and safety devices.
4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For automatic entrances.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.

B. Certified Inspector Qualifications: Certified by AAADM.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Seismic Loads: As directed.
2. Wind Loads: As directed.

C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. (6.4 L/s x sq. m) of fixed entrance-system area when tested according to ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. All-Glass, Sliding or Telescoping Automatic Entrance:

1. Single and Biparting Sliding Units: As directed

2. Single and Biparting Telescoping-Sliding Units: As directed.

3. Configuration: Single-sliding door with one sliding leaf, transom and pocketed sidelite.

   a. Traffic Pattern: One or Two way.
   b. Emergency Breakaway Capability: As indicated on Drawings, Sliding leaf only or Sliding leaf and sidelite.
   c. Mounting: Between jambs or Surface.

4. Configuration: Biparting-sliding doors with two sliding leaves, transom and pocketed sidelites on each side.

   a. Traffic Pattern: One or Two way.
   b. Emergency Breakaway Capability: As indicated on Drawings, Sliding leaves only or Sliding leaves and sidelites.
   c. Mounting: Between jambs or Surface.

5. Configuration: Single-telescoping-sliding door with two or Biparting-telescoping-sliding doors with four sliding leaves, transom and sidelite(s).

   a. Traffic Pattern: One or Two way.

b. Emergency Breakaway Capability: As indicated on Drawings, Center leaves only or all leaves.
c. Mounting: Between jambs.

6. Operator Features:

a. Power opening and closing.
b. Drive System: Chain or belt.
c. Adjustable opening and closing speeds.
d. Adjustable hold-open time between zero and 30 seconds.
e. Obstruction recycle.
f. On-off/hold-open switch to control electric power to operator, key operated.

7. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

8. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless-steel, ball-bearing-center roller wheels.

a. Configuration: Saddle-type threshold across door opening and surface-mounted or recessed guide-track system at sidelites.
b. Configuration: No threshold across door opening and surface-mounted or recessed guide-track system at sidelites.

9. Controls: Activation and safety devices as indicated on Drawings and according to BHMA standards.

a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
b. Activation Device: Push-plate switch or on each side of door to activate door operator.
c. Safety Device: Two photoelectric beams mounted in sidelite jambs on each side of door to detect pedestrians in presence zone and to prevent door from closing.
d. Safety Device: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
e. Safety Device: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
f. Sidelite Safety Device: Presence sensor, mounted above each sidelite on side of door opening through which doors travel, to detect obstructions and to prevent door from opening.

10. Finish: Finish framing, door(s), and header with Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, baked-

enamel or powder-coat finish, high-performance organic finish (two-coat fluoropolymer), high-performance organic finish (three-coat fluoropolymer), finish matching adjacent curtain wall or finish matching adjacent storefront.

a. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: As indicated on Drawings, 1-3/4 by 4-1/2 inches (45 by 115 mm) or 1-3/4 by 6 inches (45 by 150 mm).
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch (1.6-mm) wall thickness.

B. Stile and Rail Doors: 1-3/4-inch (45-mm) thick, glazed doors with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
2. Stile Design: As indicated on Drawings, Thin stile, less than 1-3/4-inch (45-mm) nominal width, Narrow stile, 2-1/8-inch (55-mm) nominal width, Medium stile, 3-1/2-inch (90-mm) nominal width or Wide stile, more than 4-inch (100-mm) nominal width.
3. Rail Design: As indicated on Drawings, 5-inch (125-mm) nominal height, 6-1/2-inch (165-mm) nominal height or 10-inch (254-mm) nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

C. All-Glass Sliding Doors: Fabricated from 1/2-inch (13-mm) thick tempered glass, with polished vertical edges and minimum 0.125-inch (3.2-mm) thick, extruded-aluminum top and bottom rails.

1. Rail Design: 3-1/2-inch (90-mm) or 5-inch (125-mm) nominal height.

D. Sidelite(s) and Transom: 1-3/4-inch (45-mm) deep sidelite(s) and transom with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
3. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.

E. Headers: Fabricated from minimum 0.125-inch (3.2-mm) thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Surface mounted or Concealed, with one side of header flush with framing.

F. Signage: As required by cited BHMA standard.

1. Application Process: Decals, Silk-screened or Door manufacturer's standard process.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221 (ASTM B221M).
2. Sheet: ASTM B209 (ASTM B209M).

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Stainless-Steel Bars: ASTM A276/A276M or ASTM A666, Type 304 or Type 316.

D. Stainless-Steel Tubing: ASTM A554, Grade MT 304 or Grade MT 316.

E. Expanded Aluminum Mesh: Expanded or Expanded and flattened aluminum sheet according to the geometry of ASTM F1267.

F. Polycarbonate Sheet: ASTM C1349, Appendix X1, type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.

G. Glazing: As specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

I. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C1107/C1107M; of consistency suitable for application.

J. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

K. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bi- and unidirectional detection.
2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator, with contrasting-colored, engraved message.

1. Configuration: Round or Square push plate with 4-by-4-inch (100-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semi-flush in wall or Surface mounted on wall.

2. Configuration: Rectangular push plate with 2-by-4-inch (50-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semi-flush in wall, Recess mounted in door jamb, Surface mounted on wall, Surface mounted on post or Surface mounted on guide rail.

3. Push-Plate Material: Stainless steel or Plastic, as selected by Architect from manufacturer's full range.
4. Message: Plain face with no message, "Push to Open", International symbol of accessibility or International symbol of accessibility and "Push to Open."

G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Interrupt powered operation of door operator while in breakaway mode.

C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch (25-mm) long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type, as specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

    a. Keying: No master or Integrate into building master key system.
    b. Keys: Two or Three for each cylinder.

2. Deadbolts: Laminated-steel hook or Steel, mortise type, BHMA A156.5, Grade 1.
3. Two-Point Locking for Stile and Rail Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into overhead carrier assembly or threshold.
4. Three-Point Locking for Stile and Rail Sliding Doors: Mechanism in stile of active door leaf that automatically extends lockbolts into overhead carrier assembly and threshold.
5. Lock/Unlock Indicator: Lock position indicators integrated with locking system. Stile is mounted on secure side of door. Visual display of lock position as follows: "OPEN" in black letters when unlocked, and "LOCKED" in red letters when locked.
6. Armored Strike: Reinforced security strike plate.

D. Automatic Locking: Electrically controlled device mounted in header that automatically locks sliding door in closed position, preventing door panels from sliding manually. Provide fail-secure or safe operation if power fails.

1. Power Interruption: Lock shall be engaged, preventing doors from sliding manually.
2. Power Interruption: Lock shall be disengaged, allowing doors to slide manually.
3. Means of Egress: Standard breakaway feature.

E. Access-Control Locking: Electrically controlled device mounted in header that automatically locks sliding door in closed position, preventing door panels from sliding manually. Provide fail- secure or safe operation if power fails.

1. Include concealed, vertical-rod, tamper-proof exit devices, complying with UL 305, with latching into threshold and overhead carrier assembly and released by full-width panic bar, push paddle, surface mounted, recessed or flush mounted and concealed within horizontal muntin bar, prohibiting manual breakout of door(s) from exterior.
2. Power Interruption: Lock shall be engaged, preventing doors from sliding manually.
3. Power Interruption: Lock shall be disengaged, allowing doors to slide manually.
4. Means of Egress: Vertical rod exit device.
5. Include locking devices for sidelites to prevent manual breakout.

F. Uninterrupted Power Supply: UL 1778, fully integrated unit mounted within header or above ceiling.

G. Dustproof Strikes for All-Glass Sliding Doors: Recessed, floor type, BHMA A156.16, Grade 1, to receive deadbolt, as specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

H. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 ACCESSORIES

A. Guide Rails: Anodized aluminum, Baked-enamel or powder-coated aluminum or Stainless steel, fabricated from bars or tubing, minimum 30 inches (762 mm) high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than that required by BHMA A156.10 for type of door and direction of travel; with filler panel.

1. Filler Panel: Expanded aluminum mesh, Clear polycarbonate sheet or Colored polycarbonate sheet.

a. Orient expanded aluminum mesh with long dimension of diamonds parallel to top rail or perpendicular to top rail.
b. Color: Match Architect's sample or as selected by Architect from manufacturer's full range.

2. Mounting: As indicated on Drawings, Jamb and floor or Floor, freestanding.
3. Aluminum Finish: Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, Baked-enamel or powder-coat finish or Finish matching door and frame.

a. Color: Light bronze, Medium bronze, Dark bronze, Black, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

4. Stainless-Steel Finish: No. 4 directional-satin-finish stainless steel or Finish matching door and frame.

B. Guide Rails: See Section 055213 "Pipe and Tube Railings" or Section 057300 "Decorative Metal Railings."

2.9 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Provide components with concealed fasteners and anchor and connection devices.

2. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
3. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
5. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system, as specified in Section 281300 "Access Control Software and Database Management."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelite, as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage or engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.23

SECTION 084229.33 - SWINGING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior, swinging, power-operated automatic entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For swinging automatic entrances.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Indicate locations of activation and safety devices.
4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For automatic entrances.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a Certified Inspector.

B. Certified Inspector Qualifications: Certified by AAADM.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.

B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Seismic Loads: As directed.
2. Wind Loads: As directed.

C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. (6.4 L/s x sq. m) of fixed entrance-system area when tested according to ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2.3 SWINGING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances, including doors, framing, headers, door operators, controls, and accessories required for a complete installation.

B. Swinging, Power-Operated Automatic Entrance:

1. Configuration: Single-swinging door with transom.

a. Traffic Pattern: One or Two way.
b. Mounting: Between jambs or Surface.

2. Configuration: Pair of swinging doors with transom.

a. Traffic Pattern: One way, Two way, Double egress or Double swing.
b. Mounting: Between jambs or Surface.

3. Operator Features:

a. Power opening and power-assist spring closing.
b. Adjustable opening and closing speeds.
c. Adjustable hold-open time between zero and 30 seconds.
d. Adjustable backcheck and latching.
e. Obstruction recycle.
f. Automatic door re-open if stopped while closing.
g. On-off/hold-open switch to control electric power to operator, key operated.

4. Controls: Activation and safety devices as indicated on Drawings and according to BHMA standards.

a. Activation Device: Motion sensor mounted on ingress side of door header to detect pedestrians in activating zone and to open door.
b. Activation Device: Push-plate switch or on each side of door to activate door operator.
c. Safety Device: Presence sensor mounted on door header, horizontal door muntin or guide rail to detect pedestrians in presence zone and to prevent door from closing.
d. Safety Device: One photoelectric beam mounted in guide rails to detect pedestrians in presence zone and to prevent door from closing.

5. Finish: Finish framing, door(s), and header with Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, baked-enamel or powder-coat finish, high-performance organic finish (two-coat fluoropolymer), high-performance organic finish (three-coat fluoropolymer), finish matching adjacent curtain wall or finish matching adjacent storefront.

a. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: As indicated on Drawings, 1-3/4 by 4-1/2 inches (45 by 115 mm) or 1-3/4 by 6 inches (45 by 150 mm).
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch (1.6-mm) wall thickness.

B. Stile and Rail Doors: 1-3/4-inch- (45-mm-) thick, glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
2. Stile Design: As indicated on Drawings, Narrow stile, 2-1/8-inch (55-mm) nominal width or Medium stile, 3-1/2-inch (90-mm) nominal width.
3. Rail Design: As indicated on Drawings, 5-inch (125-mm) nominal height, 6-1/2-inch (165-mm) nominal height or 10-inch (254-mm) nominal height.
4. Muntin Bars: Horizontal tubular rail member for each door; match stile design and finish.

C. Sidelite(s) and Transom: 1-3/4-inch- (45-mm-) deep sidelite(s) and transom with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Muntin Bars: Horizontal tubular rail members for each sidelite; match stile design.

D. Headers: Fabricated from minimum 0.125-inch (3.2-mm) thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide

hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Surface mounted or Concealed, with one side of header flush with framing.

E. Signage: As required by cited BHMA standard.

1. Application Process: Decals, Silk-screened or Door manufacturer's standard process.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221 (ASTM B221M).
2. Sheet: ASTM B209 (ASTM B209M).

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Stainless-Steel Bars: ASTM A276/A276M or ASTM A666, type 304 or type 316.

D. Stainless-Steel Tubing: ASTM A554, Grade MT 304 or Grade MT 316.

E. Expanded Aluminum Mesh: Expanded or Expanded and flattened aluminum sheet according to the geometry of ASTM F1267.

F. Polycarbonate Sheet: ASTM C1349, Appendix X1, type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on both surfaces.

G. Glazing: As specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

I. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

J. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bi- and unidirectional detection.
2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator, with contrasting-colored, engraved message.

1. Configuration: Round or Square push plate with 4-by-4-inch (100-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semiflush in wall or surface mounted on wall.

2. Configuration: Rectangular push plate with 2-by-4-inch (50-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semiflush in wall, Recess mounted in door jamb, Surface mounted on wall, Surface mounted on post or Surface mounted on guide rail.

3. Push-Plate Material: Stainless steel or Plastic, as selected by Architect from manufacturer's full range.
4. Message: Plain face with no message, "Push to Open", International symbol of accessibility or International symbol of accessibility and "Push to Open."

G. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Interrupt powered operation of door operator while in breakaway mode.

C. Hinges:

1. Center-Pivot Sets: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
2. Offset Pivots: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
3. Butt Hinges: BHMA A156.1, Grade 1, five-knuckle, 4-1/2-by-4-inch (114-by-102-mm) ball-bearing butts.

    a. Provide nonremovable pins at hinges exposed on outside of door.
    b. Provide nonferrous hinges for doors exposed to weather.
    c. Provide three hinges at each leaf for doors up to 36 inches (914 mm) wide and 80 inches (2032 mm) tall; provide four hinges at each leaf for wider or taller doors.

4. Continuous-Geared Hinges: BHMA A156.26, Grade 1.

D. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch (25-mm) long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type, as specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

    a. Keying: No master or Integrate into building master key system.
    b. Keys: Two or Three for each cylinder.

2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
3. Two-Point Locking for Swinging Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into header or threshold.

E. Push Bars: As selected by Architect from manufacturer's full range of full-door-width, single or Manufacturer's standard surface-mounted, aluminum push bars.

F. Pull Handles: As selected by Architect from manufacturer's full range of pull handles and plates or Manufacturer's standard aluminum pull handles.

G. Thresholds: BHMA A156.21, extruded-aluminum raised thresholds; with beveled edges with a slope of not more than 1:2 and a maximum height of 1/2 inch (13 mm). Provide cutouts as required for door operating hardware.

H. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
2. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
3. Weather Sweeps: Nylon brush sweep mounted to underside of door bottom.

I. Finger Guards: Collapsible neoprene or PVC gasket.

2.8 ACCESSORIES

A. Guide Rails: Anodized aluminum, Baked-enamel or powder-coated aluminum or Stainless steel, fabricated from bars or tubing, minimum 30 inches (762 mm) high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than that required by BHMA A156.10 for type of door and direction of travel; with filler panel.

1. Filler Panel: Expanded aluminum mesh, Clear polycarbonate sheet or Colored polycarbonate sheet.

    a. Orient expanded aluminum mesh with long dimension of diamonds parallel to top rail or perpendicular to top rail.
    b. Color: Match Architect's sample or as selected by Architect from manufacturer's full range.

2. Provide intermediate rail in guide rail suitable for supporting photoelectric beams.
3. Mounting: As indicated on Drawings, Jamb and floor or Floor, freestanding.
4. Aluminum Finish: Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, Baked-enamel or powder-coat finish or Finish matching door and frame.

    a. Color: Light bronze, Medium bronze, Dark bronze, Black, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

5. Stainless-Steel Finish: No. 4 directional-satin-finish stainless steel or Finish matching door and frame.

B. Guide Rails: See Section 055213 "Pipe and Tube Railings" or Section 057300 "Decorative Metal Railings."

2.9 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Provide components with concealed fasteners and anchor and connection devices.
2. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
3. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
5. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.
2. Provide compression-type weather stripping at fixed stops of exterior doors. At locations without fixed stops, provide sliding-type weather stripping retained in adjustable strip mortised into door edge.
3. Provide weather sweeps mounted to underside of door bottoms of exterior doors.
4. Provide finger guards at each swinging-door leaf that has clearance at hinge side greater than 1/4 inch (6 mm) and less than 3/4 inch (19 mm) with door in any position. Anchor guards to hinge-jamb frame.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in sides of guide rails, with dimension above finished floor not less than 24 inches (610 mm).

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Provide thresholds at exterior doors and where indicated.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 281300 "Access Control Software and Database Management."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set thresholds, framing members, and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelite, as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage or engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.33

SECTION 084233 - REVOLVING DOOR ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual revolving door entrances.
2. Automatic revolving door entrances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For revolving door entrances.

1. Include plans, elevations, sections, and attachment details.
2. Indicate enclosures, speed-control units, and other components not in manufacturer's product data.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of revolving door entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Revolving Door Entrances: Three years from date of Substantial Completion.
2. Warranty Period for Speed-Control Units: Five years from date of Substantial Completion.
3. Warranty Period for Finishes: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Revolving Door Entrance Standard: BHMA A156.27.

B. Regulatory Requirements: Wings shall be capable of collapsing into a book-fold position to provide minimum aggregate parallel width of 36 inches (914 mm) when breakaway force of no more than 130 lbf (572N) or 180 lbf (801N) is applied within 3 inches (76 mm) of outer edges. Set maximum turning speed to comply with requirements of authorities having jurisdiction.

C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201.

2.2 MANUAL REVOLVING DOOR ENTRANCES

A. Manual Revolving Door Entrances: Manufacturer's standard three-wing or four-wing manual revolving door entrance, complete with center shaft, speed-control unit, wings, hardware, enclosure walls, canopy, glass and glazing, and accessories.

1. Manual Speed-Control Unit: Mechanical speed regulator that allows free rotation of wings up to a predetermined rate of speed and that engages a clutch-type brake to prevent rapid acceleration of wings.

    a. Location: Recessed, floor mounted or Overhead.
    b. Fold-to-Side Mechanism: Manufacturer's standard overhead carriage, guide support track, pivot mechanism, and other components necessary to permit folded wings to be moved to one side of revolving door entrance enclosure.

2. Stile-and-Rail Wings: Manufacturer's standard with 1-3/4-inch (45-mm) thick tubular stile-and-rail members.

    a. Stile Design: Narrow stile, 2-inch (51-mm) nominal width, Medium stile, 3-1/2-inch (89-mm) nominal width, Wide stile, 5-inch (127-mm) nominal width or as indicated on Drawings.
    b. Rail Design: 3-inch (76-mm) nominal height, 4-inch (102-mm) nominal height or as indicated on Drawings.
    c. Muntin Design: To match stile design.
    d. Glass: Clear or Tinted, fully tempered float glass.

        1) Thickness: 6 mm, 8 mm or 10 mm.
        2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

3. Push Bars: Manufacturer's standard push bars, finished to match wings.

    a. Shape: Round bars, 1 inch (25 mm) in diameter, Flat bars, 1/2 inch thick and 1-1/2 inches (13 mm thick and 38 mm) high or Manufacturer's standard.

4. Locks: Manufacturer's standard deadbolt locks to receive cylinders; minimum of two for each revolving door entrance.

    a. Cylinders: Comply with requirements in Section 087100 "Door Hardware."
    b. Mounting: Surface applied or Mortised.
    c. Location: Extend bolt from bottom of wing into floor, top of wing into ceiling or bottom of wing into base of wall enclosure.

5. Enclosure Walls: Manufacturer's standard, with 1-3/4-inch (45-mm) thick tubular framing members.

    a. Configuration: Curved or Segmented.
    b. Glass: Clear or Tinted, fully tempered float glass.

        1) Thickness: 6 mm or 8 mm.
        2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

    c. Glass: Clear or Tinted laminated glass with two plies of float glass separated by an interlayer.

        1) Thickness: Two 3-mm-thick lites, Two 5-mm-thick lites, Two 6-mm-thick lites, Two 8-mm-thick lites or as indicated.
        2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

    d. Muntin Bars: Horizontal tubular rail member for each enclosure wall; match stile design.
    e. Metal-Clad Plywood: Fabricate from 3/4-inch (19-mm) thick plywood clad with metal sheet. Provide ceiling access panels for repairs to or maintenance of speed-control unit.
    f. Metal: Fabricate from minimum 0.125-inch (3.18-mm) thick, aluminum sheet. Provide ceiling access panels for repairs to or maintenance of speed-control unit.
    g. Ceiling Lights: Manufacturer's standard, consisting of two recessed light fixtures within the ceiling of the revolving door entrance enclosure, complete with lamps and translucent lenses.
    h. Canopy Roof: Manufacturer's standard construction, with material and finish matching enclosure walls where visible.

B. Materials: Extruded aluminum.

1. Main Extrusions and Tubing: Minimum wall thickness of 0.125 inch (3.2 mm).
2. Cladding: Minimum 0.04 inch (1.0 mm) thick.

C. Fabrication: Fabricate revolving door entrance components to designs, sizes, thicknesses, and configurations indicated with profiles that are sharp, straight, and free of defects or deformations. Accurately fit joints with ends coped or mitered to produce hairline joints free of

burrs and distortion. Prefit all hardware at the factory. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.

1. Wings: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

    a. Glaze wings at the factory. Comply with glazing requirements specified in this Section and in Section 088000 "Glazing." Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
    b. Provide sliding weather stripping, mortised into stiles and rails of wings, to be adjustable and replaceable without dismantling wings.
    c. Welded Construction: Weld reinforcement firmly in place. Weld corners. Grind and polish welds to produce an invisible joint. Mechanically finish exposed surfaces after fabrication to eliminate surface blemishes caused by welding, rolling, bending, and forming.
    d. Mechanically Joined Construction: Joints shall be tightly bolted together. Glass stops shall be snap-in type where possible.
    e. Mechanically Joined Clad Construction: Joints shall be tightly bolted together to produce hairline joints. Finish material before fabrication. Carefully assemble to prevent welds or adhesives from blemishing finished surfaces. Glass stops shall be snap-in type where possible.

2. Enclosure Walls and Canopy: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints, according to manufacturer's standards and as specified. Provide subframes as required for a complete system to support required loads.

    a. Exterior Framing: Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior. Provide anchorage and alignment brackets for concealed support of assembly from the building structure. Allow for thermal expansion of exterior units.

D. Aluminum Finishes: Clear anodic, Color anodic, Baked enamel or powder coat or High performance, organic.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.3 AUTOMATIC REVOLVING DOOR ENTRANCES

A. Automatic Revolving Door Entrances: Manufacturer's standard two-wing, three-wing or four-wing automatic revolving door entrance, complete with center shaft, core or core with rotating glazed display case, speed-control unit, wings, hardware, enclosure walls, canopy, glass and glazing, activation devices, safety devices, and accessories.

1. Powered Speed-Control Unit: Provide an electric or electrohydraulic speed regulator to permit automatic rotation of wings. Unit shall allow for manual operation when power is

off. Furnish power-operation equipment to suit current characteristics of building electrical service.

a. Location: Recessed, floor mounted or Overhead.
b. Fold-to-Side Mechanism: Manufacturer's standard overhead carriage, guide support track, pivot mechanism, and other components necessary to permit folded wings to be moved to one side of revolving door entrance enclosure.

2. Manual-Push Activation: Pushing wing activates unit and maintains rotation of wings for manufacturer's standard preset time.
3. Continuous Operation: Wings revolve continuously.
4. Signal Activation: Signal from activation device begins and maintains rotation of wings for manufacturer's standard preset time.

a. Motion Detectors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; to provide adjustable detection-field sizes, patterns, and functions required by BHMA A156.10. Mount centered on both sides of canopy fascia.
b. Presence Detectors: Self-contained, infrared-scanner units with metal or plastic housing; to provide adjustable detection-field sizes, patterns, and functions required by BHMA A156.10. Detectors shall remain active at all times. Mount recessed in canopy ceiling or on each wing.
c. Combination Motion-Presence Detectors: Self-contained, one-piece units consisting of both motion and presence detectors in a single metal or plastic housing adjustable to provide detection-field sizes, patterns, and functions required by BHMA A156.10. Mount on both sides of canopy fascia.
d. Photoelectric Beams: Pulsed infrared, sender-receiver assembly recessed in canopy ceiling or on each wing.
e. Control Mats: 1/2-inch (13-mm) thick, synthetic-rubber or flexible-plastic mat in safety-ribbed surface pattern, with extruded-aluminum frame; with pressure switches for low-voltage control wiring; and complying with performance requirements in BHMA A156.10 including Appendix A.

1) Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors.
2) Frame: Recessed to fit flush with floor; with concealed anchors or Surface mounted; with tapered safety edge.

f. Push-Plate Switch: Momentary-contact control switch with flat stainless-steel push plate engraved with message "Push to Open" or plastic push plate engraved with message "Push to Open" in contrasting color.

1) Mounting: Recess mounted, semiflush in wall, Surface mounted on wall, Surface mounted on bollard or as indicated on Drawings on right-hand side of opening.

g. Push-Button Switch: Momentary-contact control switch with one red-button actuator. Provide blue plastic cover engraved with message "Press to Open" in white letters.

1) Mounting: Recess mounted, semiflush in wall, Surface mounted on wall, Surface mounted on bollard or as indicated on Drawings on right-hand side of opening.

h. Key Switch: Recess-mounted control switch with key-controlled actuator and enclosed in 2-by-4-inch (50-by-100-mm) junction box. Provide faceplate engraved with letters indicating switch functions.

1) Functions: On-off, On-off, momentary contact.
2) Mounting: Recess mounted, semiflush in wall, Surface mounted on wall, Surface mounted on bollard or as indicated on Drawings on right-hand side of opening.

5. Stile-and-Rail Wings: Manufacturer's standard with 1-3/4-inch (45-mm) thick tubular stile-and-rail members.

a. Stile Design: Narrow stile, 2-inch (51-mm) nominal width, Medium stile, 3-1/2-inch (89-mm) nominal width, Wide stile, 5-inch (127-mm) nominal width or as indicated on Drawings.
b. Rail Design: 3-inch (76-mm) nominal height, 4-inch (102-mm) nominal height or as indicated on Drawings.
c. Muntin Design: To match stile design.
d. Glass: Clear or Tinted, fully tempered float glass.

1) Thickness: 6 mm, 8 mm or 10 mm.
2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

6. Push Bars: Manufacturer's standard push bars, finished to match wings.

a. Shape: Round bars, 1 inch (25 mm) in diameter, Flat bars, 1/2 inch thick and 1-1/2 inches (13 mm thick and 38 mm) high or Manufacturer's standard.

7. Locks: Manufacturer's standard deadbolt locks to receive cylinders; minimum of two for each revolving door entrance.

a. Cylinders: Comply with requirements in Section 087100 "Door Hardware."
b. Mounting:Surface applied or Mortised.
c. Location: Extend bolt from bottom of wing into floor, top of wing into ceiling or bottom of wing into base of wall enclosure.

8. Enclosure Walls: Manufacturer's standard, with 1-3/4-inch (45-mm) thick tubular framing members.

a. Configuration: Curved or Segmented.
b. Glass: Clear or Tinted, fully tempered float glass.

1) Thickness: 6 mm or 8 mm.
2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

c. Glass: Clear or Tinted laminated glass with two plies of float glass separated by an interlayer.

1) Thickness: Two 3-mm-thick lites, Two 5-mm-thick lites, Two 6-mm-thick lites, Two 8-mm-thick lites or as indicated.
2) Tint Color: Blue, Blue-green, Bronze, Green or Gray.

d. Muntin Bars: Horizontal tubular rail member for each enclosure wall; match stile design.

9. Canopy: Manufacturer's standard ceiling, fascia, roof, and framing with size, layout, materials, and exposed finishes matching enclosure walls unless otherwise indicated.

a. Metal-Clad Plywood: Fabricate from 3/4-inch (19-mm) thick plywood clad with metal sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
b. Metal: Fabricate from minimum 0.125-inch (3.18-mm) thick, aluminum sheet. Provide ceiling access panels for repairs to or maintenance of speed-control units.
c. Ceiling Lights: Manufacturer's standard, consisting of two recessed light fixtures within the ceiling of the revolving door entrance enclosure, complete with lamps and translucent lenses.
d. Canopy Roof: Manufacturer's standard construction, with material and finish matching enclosure walls where visible.

10. Rotating Glazed Display Case: Glazed enclosure incorporated into core, with framing matching wings and with panel on one side for access to display area.
11. Safety Devices: Manufacturer's standard safety devices as required to stop or slow rotation. Provide the following:

a. Emergency Stop Button: Momentary contact, red push-button switch to immediately stop wing rotation and reverse direction to entry position. Provide sign indicating "Emergency Stop."

1) Mounting: Recess mounted, semiflush in wall, Surface mounted on wall, Surface mounted on bollard or as indicated on Drawings on right-hand side of opening.

b. Slow-Speed Operation Button: Momentary contact push-button switch or plate to slow wing rotation by reducing rpm by one half. Include sign indicating operation.

1) Mounting: Recess mounted, semiflush in wall, Surface mounted on wall, Surface mounted on bollard or as indicated on Drawings on right-hand side of opening.

c. Vertical Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount on enclosure walls at vertical edge of entry.
d. Horizontal Safety Strip: Compressible safety switch consisting of an impact-pressure-activated, internal-contact switch plate encapsulated in a flexible housing. Mount at bottom edge of each wing.

B. Materials: Extruded aluminum.

1. Main Extrusions and Tubing: Minimum wall thickness of 0.125 inch (3.2 mm).

2. Cladding: Minimum 0.04 inch (1.0 mm) thick.

C. Fabrication: Fabricate revolving door entrance components to designs, sizes, thicknesses, and configurations indicated with profiles that are sharp, straight, and free of defects or deformations. Accurately fit joints with ends coped or mitered to produce hairline joints free of burrs and distortion. Prefit all hardware at the factory. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.

1. Wings: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

a. Glaze wings at the factory. Comply with glazing requirements specified in this Section and in Section 088000 "Glazing." Provide minimum clearances for thickness and type of glass indicated according to GANA's "Glazing Manual."
b. Provide sliding weather stripping, mortised into stiles and rails of wings, to be adjustable and replaceable without dismantling wings.
c. Welded Construction: Weld reinforcement firmly in place. Weld corners. Grind and polish welds to produce an invisible joint. Mechanically finish exposed surfaces after fabrication to eliminate surface blemishes caused by welding, rolling, bending, and forming.
d. Mechanically Joined Construction: Joints shall be tightly bolted together. Glass stops shall be snap-in type where possible.
e. Mechanically Joined Clad Construction: Joints shall be tightly bolted together to produce hairline joints. Finish material before fabrication. Carefully assemble to prevent welds or adhesives from blemishing finished surfaces. Glass stops shall be snap-in type where possible.

2. Enclosure Walls and Ceilings: Fabricate tubular and channel frame assemblies in configuration indicated, with welded or mechanical joints, according to manufacturer's standards and as specified. Provide subframes as required for a complete system to support required loads.

a. Exterior Framing: Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior. Provide anchorage and alignment brackets for concealed support of assembly from the building structure. Allow for thermal expansion of exterior units.

D. Aluminum Finishes: Clear anodic, Color anodic, Baked enamel or powder coat or High performance, organic.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

2. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Steel: ASTM A36/A36M plate, shapes, and bars; or ASTM A1008/A1008M sheet.

C. Fasteners: Manufacturer's standard, of same basic metal as fastened metal, unless otherwise indicated.

D. Weather Stripping: Heavy-duty, single-piece rubber or combination of rubber and felt.

E. Nonshrink, Nonmetallic Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C1107/C1107M; of consistency suitable for application.

F. Corrosion-Resistant Coating: Cold-applied asphalt mastic.

2.5 FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

D. High-Performance Organic Finish: Two-coat or Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight. Do not install damaged components.

1. Where aluminum contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum contacts concrete or masonry, protect against corrosion by painting contact surfaces with corrosion-resistant coatings.

B. Recessed, Floor-Mounted Speed-Control Unit: Insert control unit in rough-in floor opening set on level bed of nonshrink, nonmetallic grout. Fill annular space between control unit and sides of recess with nonshrink, nonmetallic grout. Mix and place grout to comply with grout manufacturer's written instructions.

1. Connect speed-control unit to electrical power distribution system.

C. Overhead-Mounted Speed-Control Unit: Insert pivot bearing in rough-in floor opening set on level bed of nonshrink, nonmetallic grout. Fill annular space between pivot bearing and sides of recess with nonshrink, nonmetallic grout. Mix and place grout to comply with grout manufacturer's written instructions.

1. Connect speed-control unit to electrical power distribution system.

D. Install revolving door entrances according to manufacturer's written instructions, plumb and true, without warp or rack of framing members and wings. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the assembly to exterior.
3. Cut and trim framing during installation only with approval of manufacturer.

    a. Restore finish and remove and replace members, as directed, where cutting and trimming have impaired strength or appearance.
    b. Do not install members that are warped, bowed, deformed, or otherwise damaged or defaced to such an extent as to impair strength or appearance. Remove and replace members that have been damaged during installation.

E. Activation and Safety Devices: Adjust devices to provide detection field and functions indicated.

F. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.

1. Set continuous sill members and flashings in full sealant bed.
2. Seal perimeter of framing members with sealant.

G. Adjust wings to provide an even, tight fit at contact points and weather stripping for smooth operation and weathertight closure. Adjust wings to operate smoothly and rotate evenly, with hardware and operators functioning properly.

1. Lubricate operating hardware and other moving parts.
2. Adjust speed-control unit for specified rpm.
3. Adjust pressure for collapse of wings for specified breakaway force.

H. Readjust wings and speed-control units after three days' use by normal traffic. Lubricate hardware and other moving parts.

END OF SECTION 084233

SECTION 084243 - INTENSIVE CARE UNIT/CRITICAL CARE UNIT (ICU/CCU) ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manually operated, intensive care unit/critical care unit (ICU/CCU) entrances for individual special-care rooms.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each configuration of ICU/CCU entrance indicated.

B. Sustainable Design Submittals: As submitted.

C. Shop Drawings: For each ICU/CCU installation.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.

D. Samples: For each exposed product and for each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of ICU/CCU entrances that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair finishes or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Opening Force: Not more than 5 lbf (22.2 N) to fully open door.

B. Air Leakage: Entrance assemblies for smoke control and pressurized rooms shall be listed and labeled for smoke and draft control by qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and having maximum air leakage according to NFPA 105 unless otherwise indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SLIDING ICU/CCU ENTRANCE ASSEMBLIES

A. General: Provide manufacturer's factory-glazed ICU/CCU entrances indicated including door leaves, sidelites, framing, headers, carrier assemblies, roller tracks, and accessories required for a complete installation.

B. Breakaway Hardware: Release hardware that allows indicated panels to swing out in direction of egress to full 90 degrees from closed door position.

1. Maximum Force to Open Panel: 50 lbf (222 N).
2. Release Position: Sliding door fully open or at any point in sliding-door travel.

C. Sliding ICU/CCU Entrance:

1. Performance: Standard assembly, Smoke-control assembly or Pressurized-entrance assembly.
2. Configuration: Single-sliding two-panel door, with one operable leaf and sidelite; with breakaway hardware for sliding leaf only, for sliding leaf and sidelite as indicated on Drawings.
3. Configuration: Single-sliding three-panel door, with one operable leaf and two sidelites; with breakaway hardware for sliding leaf only, for sliding leaf and one sidelite, for sliding leaf and both sidelites or as indicated on Drawings.
4. Configuration: Biparting-sliding four-panel door, with one operable leaf and sidelite on each side; with breakaway hardware for sliding leaves only, for sliding leaves and both sidelites or as indicated on Drawings.
5. Mounting: Between jambs or Surface.
6. Floor Track Configuration: No track across sliding-door opening and at sidelites (trackless), recessed, pin-guide track system at sidelites or surface-mounted, roller-guide track system at sidelites.

7. Stile Design: Narrow stile; 2-1/8-inch (55-mm) nominal width, Medium stile; 3-1/2-inch (90-mm) nominal width, Wide stile; more than 4-inch (100-mm) nominal width or as indicated on Drawings.
8. Rail Design: 3-1/2-inch (90-mm) nominal height, 5-inch (125-mm) nominal height or as indicated on Drawings.
9. Muntin Bars: On sidelites only, n doors and sidelites or None.
10. Glazing Stops and Gaskets: Beveled or Square.
11. Glazing: Clear tempered, Electrochromic or Miniblinds.
12. Finish framing, door(s), sidelite(s), and header with Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, baked-enamel or powder-coat finish or high-performance organic finish (two-coat fluoropolymer).

    a. Color: Light bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.3 COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: 1-3/4 by 4-1/2 inches (45 by 115 mm), 1-3/4 by 6 inches (45 by 150 mm) or as indicated on Drawings.
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch (1.6-mm) wall thickness.

B. Stile and Rail Doors: 1-3/4-inch (45-mm) thick, glazed doors with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded or incorporate concealed tie rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets for glazing indicated.
2. Muntin Bars: Horizontal tubular rail member for each door; match stile design.

C. Sidelites: 1-3/4-inch (45-mm) deep sidelites with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular stile and rail members matching door design and finish.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
2. Muntin Bars: Horizontal tubular rail member for each sidelite; match stile design.

D. Glazing: As specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

E. Electrochromic Glazing: As selected by Architect from full range of manufacturer's products.

F. Miniblind Glazing: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear, Gray, Bronze or Green.
b. Kind: Fully tempered, as directed.

2. Integral Miniblinds: Manufacturer's standard, horizontal louver blinds with aluminum slats and polyester-fiber cords; located in space between glass lites and operated by hardware located on inside or outside face of glass panel.

a. Operation: Tilt only or Tilt, raising, and lowering.
b. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Headers: Fabricated from minimum 0.125-inch (3.2-mm) thick, extruded aluminum, and extending full width of ICU/CCU entrance units to conceal carrier assemblies and roller tracks. Provide hinged or removable access panels for service and adjustment. Secure panels to prevent unauthorized access.

1. Capacity: Capable of supporting doors up to 100 lb (45 kg) per leaf over spans up to 14 feet (4.3 m) without intermediate supports.
2. Provide sag rods for spans exceeding 14 feet (4.3 m).

H. Carrier Assemblies and Overhead Roller Tracks: Assembly that allows vertical adjustment; consisting of nylon- or polyoxymethylene (POM)-covered, ball-bearing-center steel wheels operating on a continuous roller track or of ball-bearing-center steel wheels operating on a nylon- or POM-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly. Provide minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

I. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.4 HARDWARE

A. General: Provide units in sizes and types recommended by ICU/CCU entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Manual Flush Bolts: BHMA A156.16, Grade 1, edge mortised, lever-extension type; located at bottom of each swing-out sidelite.

C. Positive Latch: BHMA A156.5, Grade 1, manufacturer's standard latch and strike with lever handles on each side of swinging door panels. Manual flush bolt latch at each swing-out sidelite.

D. Deadlocks: Operated by exterior cylinder and interior thumb turn.

1. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
2. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type, as specified in Section 087100 "Door Hardware" or as specified in Section 087111 "Door Hardware (Descriptive Specification)."

a. Keying: No master or Integrate into building master key system and key all cylinders alike, as directed.
b. Keys: Two or Three for each cylinder.

E. Weather Stripping: Replaceable components.

F. Weather Sweeps: Nylon brush sweep mounted to underside of door bottom.

2.5 FABRICATION

A. General: Factory fabricate ICU/CCU entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

B. Framing: Provide ICU/CCU entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

E. Factory Glazing: Install electrochromic and miniblind glazing at the factory.

F. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding weather stripping, mortised into door, at perimeter of sliding surfaces and breakaway sidelites.

G. Electrical Grounding: Fabricate ICU/CCU entrances to be internally grounded, complying with requirements of authorities having jurisdiction.

2.6 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."

C. Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout complying with ASTM C1107/C1107M; of consistency suitable for application.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions, including wiring and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
2. Where aluminum contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum contacts concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Install ICU/CCU entrances plumb, true in alignment with established lines and grades, and without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Level recesses for recessed floor tracks using shrinkage-resistant grout.
4. Air Leakage: Install entrance assemblies for smoke-control and pressurized rooms according to NFPA 105 and as indicated.

C. Field Glazing: Install glazing as specified in Section 088000 "Glazing" or Section 088853 "Security Glazing."

D. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Set framing members, floor tracks, and flashings in full sealant bed.

2. Seal perimeter of framing members with sealant.

E. Grounding: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.2 ADJUSTING

A. Adjust force to open door panels.

B. Test grounding system for compliance with requirements of authorities having jurisdiction.

C. Adjust smoke-control and pressurized-entrance doors for tight closure.

D. Test and adjust electrochromic glass or miniblinds to operate properly.

END OF SECTION 084243

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storefront framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For aluminum-framed storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K), 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) or 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have a SHGC of no greater than 0.26, 0.35, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 15, 25, 35, 45, 55, 65 or 75 as determined according to NFRC 500.

I. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 STOREFRONT SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken, Thermally improved or Nonthermal.

2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides or Retained mechanically with gaskets on two sides and structural sealant on two sides.
4. Glazing Plane: Front.
5. Finish: Clear anodic finish, Color anodic finish, Baked-enamel or powder-coat finish or High-performance organic finish.
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior, interior or interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in both color coat and clear topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed storefronts or mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two or three tests in areas as directed by Architect.

2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

    a. Perform a minimum of two or three tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa) and shall not evidence water penetration.

C. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084313

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazed aluminum curtain walls.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values for each glazed aluminum curtain wall.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 or /and accredited by AAMA-certified laboratory and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Assembly Warranty: Manufacturer or Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five, 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: Five or 10 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6.35-mm) for spans of greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.29 Btu/sq. ft. x h x deg F (1.65 W/sq. m x K), 0.36 Btu/sq. ft. x h x deg F (2.04 W/sq. m x K), 0.38 Btu/sq. ft. x h x deg F (2.16 W/sq. m x K), 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K), 0.46 Btu/sq. ft. x h x deg F (2.61 W/sq. m x K) or 0.50 Btu/sq. ft. x h x deg F (2.84 W/sq. m x K) as determined according to NFRC 100.
2. SHGC: Fixed glazing and framing areas as a system shall have a SHGC of no greater than 0.22, 0.25, 0.26, 0.29, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 29, 35, 45, 55, 65 or 80 as determined according to NFRC 500.

I. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.2 m) above grade.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, Thermally improved or Nonthermal.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish, Color anodic finish, Baked-enamel or powder-coat finish, High-performance organic finish or Superior-performance organic finish.
5. Fabrication Method: Either factory- or field-fabricated system, Field-fabricated stick system, Factory-fabricated unitized system or Factory-fabricated unit and mullion system.

6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard, Compression-type, replaceable EPDM or Comply with Section 088000 "Glazing."

1. Color: Black.

C. Glazing Sealants: As recommended by manufacturer or Comply with Section 088000 "Glazing."

2.4 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior, interior or interior for vision glass and exterior for spandrel glazing or metal panels.
6. Provisions for safety railings mounted on interior face of mullions or between mullions at interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method, shear-block system, screw-spline system or head-and-sill-receptor system with shear blocks at intermediate horizontal members.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

F. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Superior Performance Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

H. Superior Performance Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story, representative areas of glazed aluminum curtain walls or mockups, as directed.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls or mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two or three tests in areas as directed by Architect.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 084423 - STRUCTURAL-SEALANT-GLAZED CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Factory or Field glazed, two-sided structural-sealant-glazed curtain-wall assemblies.
2. Factory-glazed, four-sided structural-sealant-glazed curtain-wall assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples: For each exposed finish required.

E. Delegated-Design Submittal: For structural-sealant-glazed curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C1401. Include periodic quality-control reports.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of curtain-wall assemblies.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of structural-sealant-glazed curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Structural-sealant-glazed curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6.35-mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) or 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15, 25, 35 or 45 as determined according to NFRC 500.

I. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone 1, Wind Zone 2, Wind Zone 3 or Wind Zone 4.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

K. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.

2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

L. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS: As directed.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Glazing System: Retained with structural sealant on four sides or Retained mechanically with gaskets on two sides and structural sealant on two sides.
2. Finish: Clear anodic finish, Color anodic finish, Baked-enamel or powder-coat finish or High-performance organic finish.
3. Fabrication Method: Factory-fabricated system or Either factory or field-fabricated system.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B209 (ASTM B209M).
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
d. Structural Profiles: ASTM B308/B308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: Black, Gray or as selected by Architect from manufacturer's full range of colors.

C. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

D. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

E. Glazing Sealants: As recommended by manufacturer.

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior or interior.
6. Provisions for safety railings mounted on interior face of mullions or between mullions at interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Components curved to indicated radii.

D. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion.

3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in both color coat and clear topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.7 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades.

D. Install glazing as specified in Section 088000 "Glazing."

E. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions, to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story, representative areas of structural-sealant-glazed curtain walls or mockups, as directed.

C. Field Quality-Control Testing: Perform the following test on representative areas of structural-sealant-glazed curtain walls or mockups, as directed.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two or three tests in areas as directed by Architect.

D. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two, four or six areas on each building facade.
2. Repair installation areas damaged by testing.

E. Structural-sealant-glazed curtain walls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 084423

SECTION 084433 - SLOPED GLAZING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conventionally glazed sloped glazing assemblies.
2. Two-sided, structural-sealant-glazed sloped glazing assemblies.
3. Four-sided, structural-sealant-glazed sloped glazing assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples: For each exposed finish required.

E. Delegated-Design Submittal: For sloped glazing assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C1401. Include periodic quality-control reports.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of sloped glazing assemblies.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of sloped glazing assemblies that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
2. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of sloped glazing assemblies representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Sloped glazing assemblies shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6.35-mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) or 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35, 0.40 or 0.45 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 15, 25, 35 or 45 as determined according to NFRC 500.

I. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone 1, Wind Zone 2, Wind Zone 3 or Wind Zone 4.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

K. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

L. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by sloped glazing assemblies without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS

A. Source Limitations: Obtain all components of sloped glazing assembly system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's standard, formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Framing-Member Type: Self-supporting or Skin type, supported by structural-steel members indicated.
2. Glass Retention: Field-installed pressure caps on four sides, Field-installed structural sealant at horizontal members (purlins) and pressure caps at rafters or Factory-installed structural sealant on four sides.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B209 (ASTM B209M).
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
d. Structural Profiles: ASTM B308/B308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.

b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in sloped glazing assembly indicated.

1. Color: Black, Gray or as selected by Architect from manufacturer's full range of colors.

C. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and sloped glazing assemblies manufacturers for this use.

1. Color: Match structural sealant.

D. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

E. Glazing Sealants: As recommended by manufacturer.

2.5 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior or interior.
6. Provisions for safety railings mounted on interior face of mullions or between mullions at interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Components curved to indicated radii.

D. Factory-Assembled Sloped Glazing Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Champagne or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF or FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.7 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within sloped glazing assemblies to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions, to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story, representative areas of sloped glazing assemblies or mockups, as directed.

C. Field Quality-Control Testing: Perform the following test on representative areas of sloped glazing assemblies or mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two or three tests in areas as directed by Architect.

D. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two, four or six areas on each building façade, as directed.
2. Repair installation areas damaged by testing.

E. Sloped glazing assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 084433

SECTION 084513 - STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed assemblies glazed with structured-polycarbonate panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Evaluation Research Reports: For structured-polycarbonate-panel assemblies from ICC-ES.

C. Field quality-control reports.

D. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two or Five years from date of Substantial Completion, as directed.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace structured-polycarbonate panels that exhibit defects in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/60, 1/100 or 1/120 of clear span for each assembly component.
2. Overhead Panel Assemblies: Limited to 1/60, 1/100, 1/120 or 1/180 of clear span for each assembly component.

C. Structural-Test Performance: ASTM E330.

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified deflection limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

F. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

G. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K) or 0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K) as determined according to NFRC 100.
2. Solar-Heat-Gain Coefficient (SHGC): Fixed glazing and framing areas shall have an SHGC of no greater than 0.6 or 0.7 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2.2 STRUCTURED-POLYCARBONATE-PANEL ASSEMBLIES

A. Structured-Polycarbonate-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with structured-polycarbonate panels.

2.3 STRUCTURED-POLYCARBONATE PANELS

A. Structured-Polycarbonate Panels: Translucent, extruded-polycarbonate sheet with multiwall cellular cross section that provides isolated airspaces and that is coextruded with a UV-protective layer.

B. Panel Thickness: Nominal 5/16 inch (8 mm), 3/8 inch (10 mm), 1/2 inch (12 mm), 5/8 inch (16 mm) or 1 inch (25.4 mm).

C. UV Resistance: Not required, on outer surface or on both surfaces.

D. Color: Transparent, colorless, White, Bronze, Gray, Green, Blue or as selected by Architect from manufacturer's full range.

E. Panel Performance:

1. Plastic Self-Ignition Temperature: 650 deg F (343 deg C) or more according to ASTM D1929.
2. Smoke-Developed Index: 450 or less according to ASTM E84, or 75 or less according to ASTM D2843.
3. Combustibility Classification: Class CC1 or Class CC2 based on testing according to ASTM D635.

4. Roof-Covering Classification: Class A, Class B or Class C according to ASTM E108 or UL 790.
5. Interior Finish Classification: Class A, Class B or Class C based on testing according to ASTM E84.
6. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.

    a. Outdoor Weathering Conditions: 60 months in Arizona or 120 months in a moderate North American climate.

7. Impact Resistance: No failure at impact of 200 ft. x lbf (271 J) according to freefalling-ball impact test using a 3-1/2-inch- (89-mm-) diameter, 6.3-lb (2.9-kg) ball.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: One piece, extruded aluminum or thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209 (ASTM B209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B429 (/B 429M).
4. Structural Profiles: ASTM B308 (/B 308M).

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 (/A 123M) or ASTM A153 (/A 153M) requirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch (1.02 mm), 0.050 inch (1.27 mm) or 0.063 inch (1.60 mm) thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard gasket system with low-friction surface treatment designed specifically for retaining structured-polycarbonate panels.

J. Frame-System Sealants: As recommended in writing by manufacturer or specified in Section 079200 "Joint Sealants."

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two, Three or Four-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m), but no greater than 1/2 inch (12 mm) over total length.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.

END OF SECTION 084513

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panel.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For panel assemblies. Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Evaluation Research Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.

C. Field quality-control reports.

D. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two or Five years from date of Substantial Completion, as directed.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/60, 1/90 or 1/120 of clear span for each assembly component.
2. Overhead Panel Assemblies: Limited to 1/60, 1/90, 1/120 or 1/180 of clear span for each assembly component.

C. Structural-Test Performance: ASTM E330.

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa), 10 lbf/sq. ft. (480 Pa) or 15 lbf/sq. ft. (720 Pa).

F. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

G. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K) or 0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a SHGC of no greater than 0.6 or 0.7 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.

2.3 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

B. Panel Thickness: 2-3/4 inches (70 mm) or 1-1/2 to 1-9/16 inches (38 to 40 mm).

C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch (11.1 mm).

1. Extruded Aluminum: ASTM B221 (ASTM B221M), in alloy and temper recommended in writing by manufacturer.
2. I-Beam Construction: One piece, extruded aluminum or thermally broken, extruded aluminum.
3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches (305 by 610 mm), Staggered rectangle, nominal 12 by 24 inches (305 by 610 mm), Square, nominal 12 inches (305 mm) or as indicated on Drawings.

D. Exterior Face Sheet:

1. Thickness: 0.070 inch (1.78 mm), 0.060 inch (1.52 mm) or 0.052 inch (1.32 mm).
2. Color: White, Crystal or as selected by Architect from manufacturer's full range.

3. Protective Weathering Surface: Manufacturer's standard, Integral, embedded-glass erosion barrier or Surface-applied, polyvinyl-fluoride film not less than 1.0 mils (0.03 mm) thick.

E. Interior Face Sheet:

1. Thickness: 0.045 inch (1.14 mm) or 0.060 inch (1.52 mm).
2. Color: White, Crystal or as selected by Architect from manufacturer's full range.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Strength:

1. Maximum Panel Deflection: 3-1/2 inches (89 mm) when a 4-by-12-foot (1.2-by-3.6-m) panel is tested according to ASTM E72 at 34 lbf/sq. ft. (1.6 kPa), with a maximum 0.090-inch (2.3-mm) set deflection after five minutes.
2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf (1334-N) concentrated load when applied to a 3-inch (76-mm) diameter disk according to ASTM E661.

H. Panel Performance:

1. Self-Ignition Temperature: 650 deg F (343 deg C) or more according to ASTM D1929.
2. Smoke-Developed Index: 450 or less according to ASTM E84, or 75 or less according to ASTM D2843.
3. Combustibility Classification: Class CC1 or Class CC2 based on testing according to ASTM D635.
4. Roof-Covering Classification: Class B, Class B, Burning Brand Test or Class C according to ASTM E108 or UL 790.
5. Interior Finish Classification: Class A, Class B or Class C based on testing according to ASTM E84.
6. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.

    a. Outdoor Weathering Conditions: Sixty months in southern Florida.

7. Impact Resistance: No fracture or tear at impact of 60 ft. x lbf (81 J), 70 ft. x lbf (95 J) or 230 ft. x lbf (312 J) by a 3-1/4-inch (83-mm) diameter, 5-lb (2.3-kg) freefalling ball according to UL 972 test procedure.

2.4 ALUMINUM FRAMING SYSTEMS

A. Components: One-piece, extruded aluminum or thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209 (ASTM B209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

3. Extruded Structural Pipe and Tubes: ASTM B429 (/B 429M).
4. Structural Profiles: ASTM B308 (/B 308M).

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 (/A 123M) or ASTM A153 (/A 153M) requirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch (1.02 mm), 0.050 inch (1.27 mm) or 0.063 inch (1.60 mm) thick, finished to match framing.

I. Framing Gaskets: Manufacturer's standard.

J. Frame-System Sealants: As recommended in writing by manufacturer or specified in Section 079200 "Joint Sealants."

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two, Three or Four-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m), but no greater than 1/2 inch (13 mm) over total length.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.

END OF SECTION 084523

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum windows for exterior locations.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: Five, 10 or 20 years from date of Substantial Completion, as directed.
c. Aluminum Finish: 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R, LC, CW, AW or as indicated on Drawings.
2. Minimum Performance Grade: 15, 20, 25, 30, 35, 40, 45, 50 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30 or 0.27.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45 or 52.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 ALUMINUM WINDOWS

A. Operating Types: As indicated on Drawings.

B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

C. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

D. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear, Gray, Bronze or Green.
b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two or Three.
3. Filling: Fill space between glass lites with air or argon.
4. Low-E Coating: Pyrolytic on second surface, Sputtered on second surface, Sputtered on third surface or Sputtered on second or third surface.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

a. Type and Style: Match Architect's sample or as selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Non-friction type, not less than two per sash.
3. Lock: Manufacturer's standard.
4. Limit Devices: Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

H. Hung Window Hardware:

1. Counterbalancing Mechanism: AAMA 902.
2. Locks and Latches: Operated from the inside only.
3. Tilt Latch: Releasing latch allows sash to pivot about horizontal axis.

I. Horizontal-Sliding Window Hardware:

1. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.
2. Locks and Latches: Operated from the inside only.
3. Roller Assemblies: Low-friction design.

J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Dividers (False Muntins): Provide extruded-aluminum divider grilles in designs indicated for each sash lite.

1. Type: Permanently located at exterior lite or Permanently located between insulating-glass lites.
2. Pattern: As indicated on Drawings.
3. Profile: As selected by Architect from manufacturer's full range.

B. Subsills: Thermally broken or Nonthermal, extruded-aluminum subsills in configurations indicated on Drawings.

C. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

E. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

F. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out; Full, outside for project-in; Full, outside for double-hung; Half, outside for single-hung; Full, outside for sliding or Half, outside for sliding sashes.

B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.

C. Glass-Fiber Mesh Fabric: 18-by-14 (1.1-by-1.4-mm) or 18-by-16 (1.0-by-1.1-mm), 20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm) mesh of PVC-coated, glass-fiber threads;

woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

D. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.

1. Color: Light bronze, Medium bronze, Dark bronze or Black.
2. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

E. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: Light bronze, Medium bronze, Dark bronze or Black.
2. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

F. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic or polyester enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.
2. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

G. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 50 or 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 or AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

H. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113

SECTION 085119 - STAINLESS STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stainless-steel windows from cold-rolled members.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For cold-rolled stainless steel windows.

D. Samples: For each exposed product and for each finish specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating cold-rolled stainless-steel windows that meets performance requirements indicated and of documenting performance by labels, test reports, and calculations.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of cold-rolled stainless-steel windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two or Three years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. SWI Standards: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" and "Specifications: Cold-Rolled," except where more stringent requirements are indicated.

B. Structural Wind Loads: As indicated on Drawings.

C. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressures.

D. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, cold-rolled stainless-steel windows do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Not more than 0.37 cfm/ft. (0.18 L/s/m) of sash crack length at an inward test pressure of 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E283.

F. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of 5 gal./h/sq. ft. (0.05 L/s/sq. m) with a differential pressure across the window of 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E331.

G. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.80 Btu/sq. ft. x h x deg F (4.57 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

H. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30, 0.27 or 0.80.

I. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

J. Fire-Test-Response Characteristics: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 COLD-ROLLED STAINLESS-STEEL WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Project in.
2. Casement: Project out.
3. Double hung.
4. Single hung.
5. Horizontal sliding.
6. Awning: Project out.
7. Hopper: Project in.
8. Fixed.

B. Cold-Rolled Steel Windows: Provide frame and sash members mechanically formed from cold-rolled, ASTM A240/A240M, austenitic stainless-steel sheet, Type 304 or Type 316. Comply with SWI specifications for combined weight of frame and sash members and front-to-back depth of frame or sash members.

C. Window Finish: Directional Satin Finish: No. 4, Dull Satin Finish: No. 6, Mirrorlike Reflective, Nondirectional Polish: No. 8 or Bright, Cold-Rolled, Unpolished Finish: No. 2B.

D. Mullions: Formed of cold-rolled stainless-steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.

E. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.

F. Glazing Stops: Provide screw-applied or snap-on glazing stops; coordinate with Section 088000 "Glazing" and with glazing system indicated. Provide glazing stops to match panel frames. Finish glazing stops to match window units if fabricated of steel; otherwise, provide manufacturer's standard finish.

G. Weather Stripping: Manufacturer's standard compressible weather stripping, complying with AAMA 701/702, ASTM C509, or ASTM C864 and designed for permanently resilient sealing under compression and for complete concealment when sash is closed.

2.4 GLAZING

A. Glass and Glazing System: See Section 088000 "Glazing" for glass units and glazing requirements for cold-rolled stainless-steel windows.

2.5 HARDWARE

A. General: Provide manufacturer's standard nonremovable, solid-bronze, malleable-iron or die-cast-metal hardware, with operating components of stainless steel, carbon steel complying with

AAMA 907, brass, bronze, or other corrosion-resistant material designed to smoothly operate, tightly close, and securely lock cold-rolled stainless-steel window sash; and sized to accommodate sash weight and dimensions.

B. Self-Closing Device for Fire-Rated Windows: Manufacturer's standard heat-activated self-closing device complying with NFPA 80.

C. Casement Window Hardware:

1. Gear-Type Rotary Operator: Complying with AAMA 901 when tested according to ASTM E405, Method A; located on jamb at sill.
2. Lock: Combination lever-handle and cam-type latch.
3. Friction Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
4. Friction Hinges for Emergency Escape and Rescue: Standard-duty, concealed, four-bar friction egress hinges with adjustable slide shoes; two per sash where indicated. Provide hinge designed to achieve 90-degree sash opening.
5. Butt Hinges: Heavy-duty, three-knuckle butt hinges with nylon bushings; two per sash.
6. Extension Hinges or Pivots: Nonfriction type; two per sash.
7. Lock: Lift-type, cam-action lock with keeper or Lever-handle and cam-action lock with keeper.
8. Limit Device: Adjustable, concealed friction adjustor/stay-bar or friction adjustor/stay-bar with release key or tool.

D. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Cam-action sweep lock and keeper on meeting rail; one or two per sash.
3. Handles: Lift or Pull-down handle; one or two per sash.

E. Horizontal-Sliding Window Hardware:

1. Rollers: Steel, lubricated, ball-bearing rollers.
2. Lock: Manufacturer's standard, designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and to operate from the inside only
3. Limit Device: Manufacturer's standard.
4. Pull Handle: Manufacturer's standard.

F. Projected Window Hardware:

1. Operating Device: Gear-type rotary complying with AAMA 901 when tested according to ASTM E405, Method A, Push-bar-type or underscreen sash operator located at sill.
2. Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
3. Hinges: Balance arms with adjustable, nonabrasive friction pivots; two per sash.
4. Hinges: Balance arms with adjustable, nonabrasive friction shoes; two per sash.
5. Lock: Cam-action, sweep lock handle with surface-mounted strike.
6. Lock: Key-operated security lock and keeper.

7. Limit Device: Adjustable, concealed friction adjustor/stay-bar, friction adjustor/stay-bar with release key or tool or support arms with adjustable, limited hold-open limit devices designed to restrict sash opening.

2.6 INSECT SCREENS

A. Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, fully integrated with window. Locate screens on inside or outside of window and provide for each operable exterior sash. Comply with SMA 1201.

B. Stainless-Steel Screen Frames: Fabricate frames of tubular-shaped, nonmagnetic stainless-steel members of 0.02-inch (0.5-mm) minimum wall thickness; in No. 2B bright mill finish or finish to match cold-rolled stainless-steel window.

C. Glass-Fiber Mesh Fabric: Complies with ASTM D3656, 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645 sq. mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration.

D. Aluminum Wire Fabric: 18-by-16 count per sq. in. (645 sq. mm) mesh of 0.011-inch (0.28-mm) diameter, coated aluminum wire.

E. Stainless-Steel Wire Fabric: 18-by-16 or 18-by-18 count per sq. in. (645 sq. mm) mesh of 0.009-inch (0.2-mm) minimum diameter, nonmagnetic stainless-steel wire, Type 304 or 316.

F. Wickets: Provide sliding or hinged wickets, framed and trimmed for a tight fit and durability during handling.

2.7 ACCESSORIES

A. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of cold-rolled stainless-steel windows.

B. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A123/A123M. Provide units with sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Impact Resistance: Provide anchors and clips of same design used to pass windborne-debris-impact-resistance testing.

2.8 FABRICATION

A. General: Fabricate cold-rolled stainless-steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.

B. Prepare windows for site glazing.

C. Subframes and Operable Sash: Formed of cold-rolled stainless steel of profile indicated. Miter or cope corners, and mechanically fasten and seal joints or weld and dress joints smooth.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

E. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

2.9 STAINLESS-STEEL SHEET FINISHES

A. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

A. SWI Publication: Comply with applicable requirements in SWI's "General Guidelines on the Installation of Steel Windows," except where more stringent requirements are indicated.

B. Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components.

C. Windborne-Debris Impact Resistance: Anchor cold-rolled stainless-steel windows required to have windborne-debris resistance to structure using method, anchor type, and anchor spacing identical to that used in windborne-debris-impact-resistance testing.

D. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

END OF SECTION 085119

SECTION 085123.13 - HOT-ROLLED STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes steel windows from hot-rolled members.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For hot-rolled steel windows.

D. Samples: For each exposed product and for each color specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating hot-rolled steel windows that meet performance requirements indicated and of documenting performance by labels, test reports, and calculations.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of hot-rolled steel windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: Two or Three years from date of Substantial Completion, as directed.

b. Finish: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. SWI Standards: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" and "Specifications: Hot-Rolled," except where more stringent requirements are indicated.

B. Structural Wind Loads: As indicated on Drawings.

C. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressures.

D. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, hot-rolled steel windows do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration for Weather-Stripped Sash: Not more than 0.37 cfm/ft. (0.18 L/s/m) of sash crack length at an inward test pressure of 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E283.

F. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of 5 gal./h/sq. ft. (0.05 L/s/sq. m) with a differential pressure across the window of 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E331.

G. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.80 Btu/sq. ft. x h x deg F (4.57 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

H. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30, 0.27 or 0.80.

I. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

2.3 HOT-ROLLED STEEL WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement.
2. Horizontally pivoted.
3. Vertically pivoted.
4. Awning: Project out.
5. Hopper: Project in.
6. Fixed.

B. Hot-Rolled Steel Windows: Provide frame and sash members formed from hot-rolled, new billet steel sections. Provide combined weight of frame and sash members and depth of frame or sash members according to the SWI specifications category for Light Intermediate, Standard Intermediate, Heavy Intermediate or Heavy Custom hot-rolled steel windows.

C. Window Finish: Galvanized, Galvanized and factory primed, Factory primed, Baked enamel or powder coat or High performance, organic.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. Mullions: Formed of hot-rolled steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.

E. Glazing Stops: Provide manufacturer's standard screw-applied or snap-on glazing stops fabricated from extruded or formed sheet aluminum; coordinate with Section 088000 "Glazing" for glazing system indicated. Finish glazing stops with same finish as window units if fabricated of steel; otherwise, provide manufacturer's standard finish. Match color to window units.

F. Weather Stripping: Manufacturer's standard compressible weather stripping, complying with AAMA 701/702, ASTM C509, or ASTM C864 and designed for permanently resilient sealing under compression and for complete concealment when sash is closed.

2.4 GLAZING

A. Glass and Glazing System: See Section 088000 "Glazing" for glass units and glazing requirements for hot-rolled steel windows.

2.5 HARDWARE

A. General: Provide manufacturer's standard nonremovable, solid-bronze, malleable-iron or die-cast-metal hardware, with operating components of stainless steel, carbon steel complying with AAMA 907, brass, bronze, or other corrosion-resistant material designed to smoothly operate, tightly close, and securely lock hot-rolled steel window sash; and sized to accommodate sash weight and dimensions.

B. Casement Window Hardware:

1. Gear-Type Rotary Operator: Complying with AAMA 901 when tested according to ASTM E405, Method A; located on jamb at sill.
2. Lock: Combination lever-handle and cam-type latch.
3. Friction Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
4. Friction Hinges for Emergency Escape and Rescue: Standard-duty, concealed, four-bar friction egress hinges with adjustable slide shoes; two per sash where indicated. Provide hinge designed to achieve 90-degree sash opening.
5. Butt Hinges: Heavy-duty, three-knuckle butt hinges with nylon bushings; two per sash.
6. Extension Hinges or Pivots: Nonfriction type; two per sash.
7. Lock: Lift-type, cam-action lock with keeper or Lever-handle and cam-action lock with keeper.
8. Limit Device: Adjustable, concealed friction adjustor/stay-bar or friction adjustor/stay-bar with release key or tool.

C. Pivoting Window Hardware:

1. Pivot Assembly: Manganese-bronze pivot assembly designed for center or off-center axis pivoting.
2. Lock: Internal, key-operated, limited-access locks; one or two per jamb.
3. Limit device: Adjustable, concealed friction adjustor/stay-bar or friction adjustor/stay-bar with release key or tool.

D. Projected Window Hardware:

1. Operating Device: Gear-type rotary complying with AAMA 901 when tested according to ASTM E405, Method A, Push-bar-type or underscreen sash operator located at sill.
2. Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
3. Hinges: Balance arms with adjustable, nonabrasive friction pivots; two per sash.
4. Hinges: Balance arms with adjustable, nonabrasive friction shoes; two per sash.
5. Lock: Cam-action, sweep lock handle with surface-mounted strike.
6. Lock: Key-operated security lock and keeper.
7. Pole-Operated Lock: Spring catch lock or Cam-action, sweep lock handle and keeper.
8. Pole Operators: Tubular-shaped, anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.
9. Limit Device: Adjustable, concealed friction adjustor/stay-bar, friction adjustor/stay-bar with release key or tool or support arms with adjustable, limited hold-open limit devices designed to restrict sash opening.

2.6 INSECT SCREENS

A. Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, fully integrated with window. Locate screens on inside or outside of window and provide for each operable exterior sash. Comply with SMA 1201.

B. Aluminum Screen Frames: Manufacturer's standard extruded-aluminum or formed-tubular-aluminum members; with mitered, coped joints, or corner extrusions; concealed fasteners; adjustable rollers; and removable PVC or PE spline/anchor concealing edge of mesh.

1. Finish: Baked-enamel or powder-coat or High-performance organic finish in manufacturer's standard color, color selected by the Architect from manufacturer's full range or color to match steel windows.

C. Glass-Fiber Mesh Fabric: Complies with ASTM D3656; 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645 sq. mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration.

D. Aluminum Wire Fabric: 18-by-16 count per sq. in. (645 sq. mm) mesh of 0.011-inch (0.28-mm) diameter, coated aluminum wire.

E. Wickets: Provide sliding or hinged wickets, framed and trimmed for a tight fit and durability during handling.

2.7 ACCESSORIES

A. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of hot-rolled steel windows.

B. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A123/A123M. Provide units with sufficient strength to withstand design pressure indicated.

1. Windborne-Debris-Impact Resistance: Provide anchors and clips of same design used to pass windborne-debris-impact-resistance testing.

2.8 FABRICATION

A. General: Fabricate hot-rolled steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.

B. Prepare windows for site glazing.

C. Subframes and Operable Sash: Formed of hot-rolled steel of profile indicated. Miter or cope corners, and weld and dress joints smooth.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

E. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

F. Provide water-shed members above casement or horizontal-sliding sash.

2.9 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Galvanized Finish: Hot-dip galvanize according to ASTM A123/A123M.

C. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

D. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

E. High-Performance Organic Finish: Two-coat fluoropolymer finish containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. SWI Publication: Comply with applicable requirements in SWI's "General Guidelines on the Installation of Steel Windows," except where more stringent requirements are indicated.

B. Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components.

C. Windborne-Debris-Impact Resistance: Anchor hot-rolled steel windows required to have windborne-debris resistance to structure using method, anchor type, and anchor spacing identical to that used in windborne-debris-impact-resistance testing.

D. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

E. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

F. Install windows and components to drain condensation, water-penetrating joints, and moisture migrating within windows to the exterior.

G. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E2112.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

END OF SECTION 085123.13

SECTION 085123.23 - COLD-ROLLED STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes steel windows from cold-rolled members.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For cold-rolled steel windows.

D. Samples: For each exposed product and for each color specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating cold-rolled steel windows that meets performance requirements indicated and of documenting performance by labels, test reports, and calculations.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of cold-rolled steel windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: Two or Three years from date of Substantial Completion, as directed.

b. Finish: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. SWI Standards: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" and "Specifications: Cold-Rolled," except where more stringent requirements are indicated.

B. Structural Wind Loads: As indicated on Drawings.

C. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressures.

D. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, cold-rolled steel windows do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Not more than 0.37 cfm/ft. (0.18 L/s/m) of sash crack length at an inward test pressure of 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E283.

F. Water Penetration: No leakage for 15 minutes when window is subjected to a rate of flow of 5 gal./h/sq. ft. (0.05 L/s/sq. m) with a differential pressure across the window of 2.86 lbf/sq. ft. (137 Pa) or 6.24 lbf/sq. ft. (298 Pa) when tested according to ASTM E331.

G. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.80 Btu/sq. ft. x h x deg F (4.57 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

H. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30, 0.27 or 0.80.

I. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

J. Fire-Test-Response Characteristics: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 COLD-ROLLED STEEL WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Project in.
2. Casement: Project out.
3. Double hung.
4. Single hung.
5. Horizontal sliding.
6. Awning: Project out.
7. Hopper: Project in.
8. Fixed.

B. Cold-Rolled Steel Windows: Provide frame and sash members mechanically formed from metallic-coated, low-carbon, cold-rolled steel sheet complying with ASTM A653/A653M. Comply with SWI specifications for combined weight of frame and sash members and front-to-back depth of frame or sash members.

C. Window Finish: Baked enamel or powder coat or Primed for field-painting.

1. Color: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. Mullions: Formed of cold-rolled steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.

E. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.

F. Glazing Stops: Provide screw-applied or snap-on glazing stops; coordinate with Section 088000 "Glazing" and with glazing system indicated. Provide glazing stops to match panel frames. Finish glazing stops to match window units if fabricated of steel; otherwise, provide manufacturer's standard finish.

G. Weather Stripping: Manufacturer's standard compressible weather stripping, complying with AAMA 701/702, ASTM C509, or ASTM C864 and designed for permanently resilient sealing under compression and for complete concealment when sash is closed.

2.4 GLAZING

A. Glass and Glazing System: See Section 088000 "Glazing" for glass units and glazing requirements for cold-rolled steel windows.

2.5 HARDWARE

A. General: Provide manufacturer's standard nonremovable, solid-bronze, malleable-iron or die-cast-metal hardware, with operating components of stainless steel, carbon steel complying with AAMA 907, brass, bronze, or other corrosion-resistant material designed to smoothly operate, tightly close, and securely lock cold-rolled steel window sash; and sized to accommodate sash weight and dimensions.

B. Self-Closing Device for Fire-Rated Windows: Manufacturer's standard heat-activated self-closing device, complying with NFPA 80.

C. Casement Window Hardware:

1. Gear-Type Rotary Operator: Complying with AAMA 901 when tested according to ASTM E405, Method A; located on jamb at sill.
2. Lock: Combination lever-handle and cam-type latch.
3. Friction Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
4. Friction Hinges for Emergency Escape and Rescue: Standard-duty, concealed, four-bar friction egress hinges with adjustable slide shoes; two per sash where indicated. Provide hinge designed to achieve 90-degree sash opening.
5. Butt Hinges: Heavy-duty, three-knuckle butt hinges with nylon bushings; two per sash.
6. Extension Hinges or Pivots: Nonfriction type; two per sash.
7. Lock: Lift-type, cam-action lock with keeper or Lever-handle and cam-action lock with keeper.
8. Limit Device: Adjustable, concealed friction adjustor/stay-bar or friction adjustor/stay-bar with release key or tool.

D. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Cam-action sweep lock and keeper on meeting rail; one or two per sash.
3. Handles: Lift or Pull-down handle; one or two per sash.

E. Horizontal-Sliding Window Hardware:

1. Rollers: Steel, lubricated, ball-bearing rollers.
2. Lock: Manufacturer's standard, designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and to operate from the inside only
3. Limit Device: Manufacturer's standard.
4. Pull Handle: Manufacturer's standard.

F. Projected Window Hardware:

1. Operating Device: Gear-type rotary complying with AAMA 901 when tested according to ASTM E405, Method A, Push-bar-type or underscreen sash operator located at sill.
2. Hinges: Concealed, four-bar friction hinges with adjustable slide shoes complying with AAMA 904; two per sash.
3. Hinges: Balance arms with adjustable, nonabrasive friction pivots; two per sash.
4. Hinges: Balance arms with adjustable, nonabrasive friction shoes; two per sash.
5. Lock: Cam-action, sweep lock handle with surface-mounted strike.
6. Lock: Key-operated security lock and keeper.
7. Limit Device: Adjustable, concealed friction adjustor/stay-bar, friction adjustor/stay-bar with release key or tool or support arms with adjustable, limited hold-open limit devices designed to restrict sash opening.

2.6 INSECT SCREENS

A. Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, fully integrated with window. Locate screens on inside or outside of window and provide for each operable exterior sash. Comply with SMA 1201.

B. Aluminum Screen Frames: Manufacturer's standard extruded-aluminum or formed-tubular-aluminum members; with mitered, coped joints, or corner extrusions; concealed fasteners; adjustable rollers; and removable PVC or PE spline/anchor concealing edge of mesh.

1. Finish: Baked-enamel or powder-coat or Primed finish in manufacturer's standard color, color selected by the Architect from manufacturer's full range or color to match steel windows.

C. Glass-Fiber Mesh Fabric: Complies with ASTM D3656, 18-by-14 or 18-by-16 or 20-by-20 or 20-by-30 count per sq. in. (645 sq. mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration.

D. Aluminum Wire Fabric: 18-by-16 count per sq. in. (645 sq. mm) mesh of 0.011-inch (0.28-mm) diameter, coated aluminum wire.

E. Wickets: Provide sliding or hinged wickets, framed and trimmed for a tight fit and durability during handling.

2.7 ACCESSORIES

A. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of cold-rolled steel windows.

B. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A123/A123M. Provide units with sufficient strength to withstand design pressure indicated.

1. Windborne-Debris-Impact Resistance: Provide anchors and clips of same design used to pass windborne-debris-impact-resistance testing.

2.8 FABRICATION

A. General: Fabricate cold-rolled steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.

B. Prepare windows for site glazing.

C. Subframes and Operable Sash: Formed of cold-rolled steel of profile indicated. Miter or cope corners, and mechanically fasten and seal joints or weld and dress joints smooth.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

E. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

2.9 METALLIC-COATED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780.

B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. SWI Publication: Comply with applicable requirements in SWI's "General Guidelines on the Installation of Steel Windows," except where more stringent requirements are indicated.

B. Comply with manufacturer's written instructions for installing windows, hardware, operators, accessories, and other components.

C. Windborne-Debris-Impact Resistance: Anchor cold-rolled steel windows required to have windborne-debris resistance to structure using method, anchor type, and anchor spacing identical to that used in windborne-debris-impact-resistance testing.

D. Install windows level, plumb, square, true to line, without distortion or impediment to thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

E. Separate corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to ASTM E2112.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

END OF SECTION 085123.23

SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-clad, vinyl-clad or fiberglass-clad wood windows.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

D. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 QUALITY ASSURANCE: As directed.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: Five, 10 or 20 years from date of Substantial Completion, as directed.
c. Aluminum-Cladding Finish: 10 or 20 years from date of Substantial Completion, as directed.

d. Vinyl Cladding: Lifetime warranty.
e. Fiberglass Cladding: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R, LC, CW or as indicated on Drawings.
2. Minimum Performance Grade: 15, 20, 25, 30, 35, 40, 45, 50 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30 or 0.27.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 WOOD WINDOWS

A. Aluminum-Clad Wood Windows: As directed.

B. Vinyl-Clad Wood Windows: As directed.

C. Fiberglass-Clad Wood Windows: As directed.

D. Wood Windows: As directed.

E. Operating Types: As indicated on Drawings.

F. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and

surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

1. Exterior Finish: Aluminum-clad, Vinyl-clad, Fiberglass-clad, Manufacturer's standard factory-prime coat or Unfinished wood.

    a. Aluminum Finish: Manufacturer's standard baked-on enamel finish, Manufacturer's standard high-performance organic finish or Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605.
    b. Exposed Unfinished Wood Surfaces: Manufacturer's standard paint-grade species, Pine or Mahogany.
    c. Color: As selected by Architect from manufacturer's full range.

2. Interior Finish: Unfinished, Manufacturer's standard factory-prime coat, Manufacturer's standard color-coated finish or Manufacturer's standard stain-and-varnish finish.

    a. Exposed Unfinished Wood Surfaces: Manufacturer's standard species, Pine or Mahogany.
    b. Color: As selected by Architect from manufacturer's full range.

G. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

H. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

    a. Tint: Clear, Gray, Bronze or Green.
    b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two or Three.
3. Filling: Fill space between glass lites with air or argon.
4. Low-E Coating: Pyrolytic on second surface, Sputtered on second surface, Sputtered on third surface or Sputtered on second or third surface.

I. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

J. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

K. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

    a. Type and Style: Match Architect's sample or as selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Manufacturer's standard type for sash weight and size indicated.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 29 inches (735 mm) tall and two arms on taller sashes.
4. Limit Devices: Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

L. Hung Window Hardware:

1. Counterbalancing Mechanism: AAMA 902.
2. Locks and Latches: Operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.

M. Horizontal-Sliding Window Hardware:

1. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.
2. Locks and Latches: Operated from the inside only.
3. Roller Assemblies: Low-friction design.

N. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

O. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: One per sash, removable from exposed surface of interior lite, two per sash, removable from exposed surfaces of interior and permanently located at exterior lite, two per sash, permanently located at exterior and interior lites, One permanently located between insulating-glass lites or Three per sash, two permanently located at exterior and interior lites and one permanently located between insulating-glass lites.
2. Material: Manufacturer's standard.
3. Pattern: As directed.
4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out; Full, outside for double-hung; Half, outside for single-hung; Full, outside for sliding or Half, outside for sliding sashes.

B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.

1. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
2. Finish for Exterior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range or Matching color and finish of cladding.

C. Glass-Fiber Mesh Fabric: 18-by-14 (1.1-by-1.4-mm) or 18-by-16 (1.0-by-1.1-mm), 20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze wood windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085200

SECTION 085313 - VINYL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vinyl-framed windows.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R, LC. CW or as indicated on Drawings.
2. Minimum Performance Grade: 15, 20, 25, 30, 35, 40, 45, 50 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30 or 0.27, as directed.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 VINYL WINDOWS

A. Operating Types: As indicated on Drawings.

B. Frames and Sashes: Impact-resistant, UV-stabilized PVC complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Finish: Integral color, white, beige or sandstone.
2. Gypsum Board Returns: Provide at interior face of frame.

C. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

D. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear, Gray, Bronze or Green.
b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two or Three.
3. Filling: Fill space between glass lites with air or argon.
4. Low-E Coating: Pyrolytic on second surface, Sputtered on second surface, Sputtered on third surface or Sputtered on second or third surface.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

a. Type and Style: Match Architect's sample or as selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Manufacturer's standard type for sash weight and size indicated.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 29 inches (735 mm) tall and two arms on taller sashes.
4. Limit Devices: Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

H. Hung Window Hardware:

1. Counterbalancing Mechanism: AAMA 902.
2. Locks and Latches: Operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.

I. Horizontal-Sliding Window Hardware:

1. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.
2. Locks and Latches: Operated from the inside only.
3. Roller Assemblies: Low-friction design.

J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: One permanently located between insulating-glass lites or Three per sash, one permanently located between insulating-glass lites, and two permanently attached to the interior and exterior lites.
2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings.
4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out; Full, outside for double-hung; Half, outside for single-hung; Full, outside for sliding; or Half, outside for sliding sashes.

B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.

1. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
2. Finish for Exterior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range or matching color and finish of cladding.

C. Glass-Fiber Mesh Fabric: 18-by-14 (1.1-by-1.4-mm), 18-by-16 (1.0-by-1.1-mm), 20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate vinyl windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze vinyl windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, compatible with window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units. Provide manufacturer's standard finish to match window units.

E. Hardware: Mount hardware through double walls of vinyl extrusions or provide corrosion-resistant reinforcement.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085313

SECTION 085413 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fiberglass-framed windows.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace fiberglass windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: R, LC, CW or as indicated on Drawings.
2. Minimum Performance Grade: 15, 20, 25, 30, 35, 40, 45 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K) or 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40, 0.30 or 0.27, as directed.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3, 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 FIBERGLASS WINDOWS

A. Operating Types: As indicated on Drawings.

B. Frames and Sashes: Pultruded fiberglass complying with AAMA/WDMA/CSA 101/I.S.2/A440 and with exposed exterior fiberglass surfaces finished with manufacturer's standard enamel coating complying with AAMA 613 or AAMA 623.

1. Exterior Color: As selected by Architect from manufacturer's full range.
2. Interior Finish: Matching exterior color and finish, matching exterior finish, in color selected by Architect from manufacturer's full range, wood veneer clad, maple or wood veneer clad, oak.

C. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

D. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear, Gray, Bronze or Green.
b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two or Three.
3. Filling: Fill space between glass lites with air or argon.
4. Low-E Coating: Pyrolytic on second surface, Sputtered on second surface, Sputtered on third surface or Sputtered on second or third surface.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

G. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

a. Type and Style: Match Architect's sample or as selected by Architect from manufacturer's full range of types and styles.

2. Hinges: Manufacturer's standard type for sash weight and size indicated.
3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 27-1/2 inches (700 mm) tall and two arms on taller sashes.
4. Limit Devices: Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

H. Hung Window Hardware:

1. Counterbalancing Mechanism: AAMA 902.
2. Locks and Latches: Operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.

I. Horizontal-Sliding Window Hardware:

1. Sill Cap/Track: Designed to comply with performance requirements indicated and to drain to the exterior.
2. Locks and Latches: Operated from the inside only.
3. Roller Assemblies: Low-friction design.

J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: One per sash, removable from exposed surface of interior lite, two per sash, removable from exposed surfaces of interior and permanently located at exterior lite or One permanently located between insulating-glass lites.
2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings.
4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

B. Jamb Extensions: Stain-grade Pacific Hemlock.

2.4 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out; Full, outside for project-in; Full, outside for double-hung; Half, outside for single-hung; Full, outside for sliding or Half, outside for sliding sashes.

B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.

1. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
2. Finish for Exterior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range or matching color and finish of cladding.

C. Glass-Fiber Mesh Fabric: 18-by-14 (1.1-by-1.4-mm), 18-by-16 (1.0-by-1.1-mm), 20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.

1. Mesh Color: Manufacturer's standard.

2.5 FABRICATION

A. Fabricate fiberglass windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze fiberglass windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085413

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vision security windows.
2. Fixed, transaction security windows.
3. Sliding, transaction security windows.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

D. Samples: For frame members with factory-applied color finishes.

E. Delegated-Design Submittal: For security windows.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

C. Anchor inspection reports.

D. Field quality-control reports.

E. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance: Listed and labeled as, Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 9, Level 10, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG, Level 8-SG, Level 9-SG or Level 10-SG when tested according to UL 752.
2. Ballistics Resistance: Class HG1, Class HG2, Class HG3, Class HG4, Class SMG, Class R1, Class R2, Class R3, Class R4-AP, Class R5, Class SH1 or Class SH2 when tested according to ASTM F1233.
3. Ballistics Resistance: A, B, C, D or E when tested according to HPW-TP-0500.03.
4. Forced-Entry Resistance: Level I, Level II, Level III, Level IV or Level V when tested according to HPW-TP-0500.03.
5. Forced-Entry Resistance: Class 1.0, Class 1.1, Class 1.2, Class 1.3, Class 1.4, Class 1.5, Class 2.0, Class 2.1, Class 2.2, Class 2.3, Class 2.4, Class 2.5, Class 2.6, Class 2.7, Class 2.8, Class 3.0, Class 3.1, Class 3.2, Class 3.3, Class 3.4, Class 3.5, Class 3.6, Class 3.7, Class 3.8, Class 3.9, Class 3.10, Class 4.0, Class 4.1, Class 4.2, Class 4.3, Class 4.4, Class 4.5, Class 4.6, Class 4.7, Class 4.8, Class 4.9, Class 4.10, Class 4.11, Class 4.12, Class 4.13 or Class 5.0 when tested according to ASTM F1233.

B. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 VISION SECURITY WINDOWS

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

B. Framing: Fabricate perimeter framing, mullions, and glazing stops from steel, metallic-coated steel sheet or stainless steel as follows:

1. Profile: Manufacturer's standard or Narrow, with minimum face dimension indicated.

a. Minimum Face Dimension: 2 inches (50 mm), 1-1/4 inches (32 mm) or as indicated on Drawings.

2. Depth: Manufacturer's standard, adjustable, two-piece clamp or as indicated on Drawings.

C. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

2.3 FIXED, TRANSACTION SECURITY WINDOWS

A. Provide fixed, transaction security windows with operable sash or ventilator capable of allowing transfer of currency and documents.

B. Configuration: One fixed-glazed panel, multiple fixed-glazed panels or as indicated on Drawings.

C. Framing: Fabricate perimeter framing, mullions, and glazing stops from steel, metallic-coated steel sheet or stainless steel as follows:

1. Profile: Manufacturer's standard or Narrow, with minimum face dimension indicated.

a. Minimum Face Dimension: 2 inches (50 mm), 1-1/4 inches (32 mm) or as indicated on Drawings.

2. Depth: Manufacturer's standard, adjustable, two-piece clamp or as indicated on Drawings.

D. Head and Jamb Framing: Designed for sealant glazing, gasket glazing or voice communication by speech at normal volume.

E. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.

1. Transaction Counter: Stainless steel, 12 inches (305 mm) or 18 inches (457 mm) deep by width of security window, with integral deal tray centered in opening or as indicated on Drawings.
2. Transaction Counter: Stainless steel, 21 inches (533 mm) deep by width of security window, with operable deal tray centered in opening or as indicated on Drawings.

F. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

G. Glazing Meeting Edges: Polished glazing.

2.4 SLIDING, TRANSACTION SECURITY WINDOWS

A. Provide sliding, transaction security windows.

B. Configuration: One fixed-glazed panel and one horizontal-sliding glazed panel, two glazed panels that slide horizontally and meet at center of security window or as indicated on Drawings.

C. Operation: Manual open/manual closing or manual open/self-closing.

D. Framing: Fabricate perimeter framing, mullions, and glazing stops from steel, metallic-coated steel sheet or stainless steel as follows:

1. Profile: Manufacturer's standard or Narrow, with minimum face dimension indicated.

a. Minimum Face Dimension: 2 inches (50 mm), 1-1/4 inches (32 mm) or as indicated on Drawings.

2. Depth: Manufacturer's standard, adjustable, two-piece clamp or as indicated on Drawings.

E. Head and Jamb Framing: Designed for sealant or gasket glazing. Removable header access panel on secure side.

F. Sill: Stainless-steel channel frame designed for sealant or gasket glazing.

1. Shelf: Stainless steel, 12 inches (305 mm) or 18 inches (457 mm) deep by width of security window, with integral deal tray.

G. Sliding Window Hardware: Provide roller track designed for overhead support of two- or four-wheel carriage, heavy-duty, antilift ball-bearing carrier or manufacturer's standard carrier supporting horizontal-sliding glazed panel with manufacturer's standard self-closing mechanism mounted in header. Provide self-latching and self-locking or manufacturer's standard pull and lock with two keys for each horizontal-sliding glazed panel.

1. Provide weather stripping for exterior horizontal-sliding, transaction security windows.

H. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

1. Glazing Meeting Edges: Polished glazing.

2.5 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
2. Prepare security windows for field glazing unless preglazing at the factory is indicated.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Thermally Improved or Thermally Broken Construction: Fabricate framing with an integral, concealed, low-conductance thermal barrier, located between exterior materials and members exposed on interior in a manner that eliminates direct metal-to-metal contact.

D. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

E. Glazing Stops: Finish glazing stops to match security window framing.

1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

F. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Factory-cut openings in glazing for speaking apertures.

H. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Installation orientation of glazing to meet performance requirements. Comply with requirements in Section 088853 "Security Glazing."

I. Weather Stripping: Factory applied.

2.6 METALLIC-COATED STEEL SHEET FINISHES

A. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.7 STEEL FINISHES

A. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

B. Baked-Enamel or Power-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.8 STAINLESS-STEEL FINISHES

A. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Directional Satin Finish: No. 4.

2.9 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel with sliding stainless-steel cover; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: As directed.

B. Recessed, Nonricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface, and with sliding stainless-steel cover.

1. Clear Opening Size: As directed.
2. Bullet Trap Location: Secure side or Both sides.
3. Ballistics Resistance: UL Level 1, UL Level 3 or same as security window.
4. Listed and labeled as bullet resisting according to UL 752.

C. Transaction Drawers: Formed from stainless steel, steel or bullet-resistant armoring; with ball-bearing, telescoping sliding mechanism; with cover on secure side of top of drawer that automatically closes when drawer is extended to attack side.

1. Inside Dimensions: As directed.
2. Operation: Manual.
3. Operation: Electric, with sliding handle for emergency manual operation during lack of power. Provide individual switches for power and drawer movement on secure side and call button on attack side.
4. Ballistics Resistance: UL Level 1, UL Level 3 or same as security window.
5. Listed and labeled as bullet resisting according to UL 752.

D. Speaking Apertures: Fabricate from stainless steel or security glazing, designed to allow passage of speech at normal speaking volume without distortion.

1. Shape: Circular or Square.
2. Ballistics Resistance: UL Level 1, UL Level 3 or same as security window.
3. Listed and labeled as bullet resisting according to UL 752.

E. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

F. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A27/A27M cast steel or ASTM A47/A47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.

G. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch (12.7-mm) diameter, headed studs welded to back of plate.

H. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

I. Glazing Strips and Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Molded EPDM or neoprene gaskets complying with ASTM D2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C509, Grade 4.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric backing.

J. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

K. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B633; provide sufficient strength to withstand design pressures indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

B. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

B. Glazed Framing: Provide sealant or gasket glazed framing. Comply with installation requirements in Section 088853 "Security Glazing."

C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.

E. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 CLEANING AND PROTECTION

A. Lubricate sliding security window hardware.

B. Lubricate transaction drawer hardware.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain operable security windows and security windows with transaction drawers.

END OF SECTION 085653

SECTION 085663 - DETENTION WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Awning detention windows.
2. Casement detention windows.
3. Fixed detention windows.
4. Air-vent detention windows.

1.2 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by a Detention Specialist or other entity.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, and attachment details.

D. Samples: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Material Certificates: For homogeneous tool-resisting steel.

C. Material test reports.

D. Product test reports.

E. Anchor inspection reports.

F. Field quality-control reports.

1. Field quality-control certification signed by Contractor and Detention Specialist.

G. Sample warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace detention windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Grade 1, Grade 2, Grade 3 or Grade 4 when tested according to ASTM F1592.

1. Ballistics Resistance: Test glazed window assembly for bullet penetration according to UL 752, Performance Level 3.
2. Dual Certification: Provide window assemblies with Grade 1, Grade 2, Grade 3 or Grade 4 glazing panels, when tested according to ASTM F1915.

B. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 AWNING DETENTION WINDOWS

A. Steel Framing: Fabricate perimeter framing, removable covers, and ventilator head rails from 0.105-inch (2.66-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet; ventilator jamb and sill framing from hot-rolled steel sections weighing not less than 1.93 lb/linear foot (2.87 kg/linear m); and 0.055-inch (1.40-mm) thick glazing stops from extruded aluminum.

B. Detention Bars:

1. Tool-Resisting-Steel Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, tool-resisting-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) tool-resisting-steel, flat bars concealed within perimeter frame.

    a. Steel: Composite, tool-resisting steel, Grade 1 or Grade 2 according to ASTM A627.
    b. Steel: Homogeneous, tool-resisting steel, Grade 3 or Grade 4 according to ASTM A627.

2. Mild-Steel Detention Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, mild-steel round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) mild-steel, flat bars concealed within perimeter frame.

C. Hardware:

1. Four-Bar Friction Hinges: Provide adjustable friction shoes of bronze, brass, nylon, or other nonabrasive, nonstaining, noncorrosive, durable material.
2. Gear-Type, Rotary, Ventilator Operators: Manufacturer's security-grade ventilator control; consisting of manual operator with worm gear, self-locking, bronze bearings, and steel linkage arms on both jambs; maximum opening of 50 degrees, with nonremovable operable knob or removable crank.

    a. Operator shall turn all ventilators simultaneously, securely closing them at both jambs without using additional manually controlled locking devices.
    b. Conceal operator, which shall be removable as a unit, within subframe.
    c. Provide one removable crank for every 10 windows.

D. Screens:

1. Fixed Angle-Frame Screens: Fabricate angle frames and removable clamp strips from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel. Match window-frame finish.
2. Wire-Fabric Screen Cloth: Manufacturer's standard mesh of 0.047-inch (1.19-mm) diameter, stainless-steel wire, complying with FS RR-W-365A.

2.3 CASEMENT DETENTION WINDOWS

A. Steel Framing: Fabricate perimeter framing and removable covers from 0.105-inch (2.66-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet; ventilator head, jamb, and sill framing from hot-rolled steel sections weighing not less than 1.93 lb/linear foot (1.3 kg/linear m); vertical muntins from 0.120-inch (3.04-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet; ventilator bedding angles from 0.060-inch (1.52-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet; and 0.055-inch 1.40-mm) thick glazing stops from extruded aluminum.

B. Detention Bars:

1. Tool-Resisting-Steel Bar Grid: 1-inch (25-mm) or 7/8-inch- (22-mm) diameter, tool-resisting-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) tool-resisting-steel, flat bars concealed within perimeter frame.

    a. Steel: Composite, tool-resisting steel, Grade 1 or Grade 2 according to ASTM A627.
    b. Steel: Homogeneous, tool-resisting steel, Grade 3 or Grade 4 according to ASTM A627.

2. Mild-Steel Detention Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, mild-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) mild-steel, flat bars concealed within perimeter frame.

C. Hardware:

1. Four-Bar Friction Hinges: Provide adjustable friction shoes of bronze, brass, nylon, or other nonabrasive, nonstaining, noncorrosive, durable material.
2. Gear-Type, Rotary, Ventilator Operators: Manufacturer's security-grade ventilator control; consisting of manual operator with worm gear, self-locking, bronze bearings, and steel linkage arms on both jambs; maximum opening of 50 degrees, with nonremovable operable knob or removable crank.

    a. Operator shall turn all ventilators simultaneously, securely closing them at both jambs without using additional manually controlled locking devices.
    b. Conceal operator, which shall be removable as a unit, within subframe.
    c. Provide one removable crank for every 10 windows.

D. Screens:

1. Fixed Angle-Frame Screens: Fabricate angle frames and removable clamp strips from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel. Match window-frame finish.
2. Wire-Fabric Screen Cloth: Manufacturer's standard mesh of 0.047-inch (1.19-mm) diameter, stainless-steel wire, complying with FS RR-W-365A.

2.4 FIXED DETENTION WINDOWS

A. Steel Framing: Fabricate perimeter framing, removable covers, and muntins or mullions from 0.105-inch (2.66-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet. Provide thermally improved construction or provide thermally broken construction.

B. Detention Bars:

1. Tool-Resisting-Steel Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, tool-resisting-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) tool-resisting-steel, flat bars concealed within perimeter frame.

    a. Steel: Composite, tool-resisting steel, Grade 1 or Grade 2 according to ASTM A627.
    b. Steel: Homogeneous, tool-resisting steel, Grade 3 or Grade 4 according to ASTM A627.

2. Mild-Steel Detention Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, mild-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) mild-steel, flat bars concealed within perimeter frame.

2.5 AIR-VENT DETENTION WINDOWS

A. Steel Framing: Fabricate perimeter framing, removable covers, integral perforated grille, ventilator frame, vent damper, and muntins or mullions from 0.105-inch (2.66-mm) nominal-thickness, metallic-coated, cold-rolled steel sheet; and glazing stops from 0.060-inch (1.5-mm) thick, extruded aluminum. Provide 10-by-10 (2.5-by-2.5-mm) stainless-steel mesh behind perforated grille.

B. Detention Bars:

1. Tool-Resisting-Steel Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, tool-resisting-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch (9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) tool-resisting-steel, flat bars concealed within perimeter frame.

    a. Steel: Composite, tool-resisting steel, Grade 1 or Grade 2 according to ASTM A627.
    b. Steel: Homogeneous, tool-resisting steel, Grade 3 or Grade 4 according to ASTM A627.

2. Mild-Steel Detention Bar Grid: 1-inch (25-mm) or 7/8-inch (22-mm) diameter, mild-steel, round bars concealed within muntins at center of window or 6 inches (152 mm) o.c., oriented along length of window unless otherwise indicated, with 3/8-by-2-1/2-inch

(9.6-by-63.5-mm), 5/16-by-2-1/4-inch (7.9-by-57.2-mm) or 1/4-by-2-inch (6-by-50-mm) mild-steel, flat bars concealed within perimeter frame.

C. Hardware:

1. Gear-Type, Rotary, Ventilator Operators: Manufacturer's security-grade ventilator control; consisting of manual operator with worm gear, self-locking, bronze bearings, and steel linkage arms on both jambs; maximum opening of 50 degrees, with nonremovable operable knob or removable crank.

   a. Operator shall turn all ventilators simultaneously, securely closing them at both jambs without using additional manually controlled locking devices.
   b. Conceal operator, which shall be removable as a unit, within subframe.
   c. Provide one removable crank for every 10 windows.

D. Screens:

1. Fixed Angle-Frame Screens: Fabricate angle frames and removable clamp strips from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel. Match window-frame finish.
2. Wire-Fabric Screen Cloth: Manufacturer's standard mesh of 0.047-inch (1.19-mm) diameter, stainless-steel wire, complying with FS RR-W-365A.

2.6 FABRICATION

A. Provide units that are reglazable from the exterior without dismantling ventilator framing.

B. Fabricate detention window frames of one-piece construction, except where removable covers are indicated.

C. Form removable covers to profiles indicated on Drawings.

D. Anchors for In-Place-Construction Installation: 3/16-inch (4.8-mm) thick steel angles or formed-steel plates, 4 inches (100 mm) long, welded to back of detention window frames as required to secure detention windows to adjacent construction.

1. Provide two anchors per side of window plus one additional anchor for every 18 inches (457 mm) or fraction thereof more than 36 inches (914 mm) in height or width.

E. Anchors for Built-in Installation: 1/2-inch (13-mm) diameter, headed studs welded to back side of frames as required to secure detention windows to adjacent construction.

1. Provide two anchors per side of window plus one additional anchor for every 18 inches (457 mm) or fraction thereof more than 36 inches (914 mm) in height or width.

F. Glazing Stop Heights: Minimum 1.25 inches (32 mm) to provide minimum 1-inch (25-mm) glass engagement.

G. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

H. Thermally Improved or Thermally Broken Construction: Fabricate framing with an integral, concealed, low-conductance thermal barrier, located between exterior materials and members exposed on interior in a manner that eliminates direct metal-to-metal contact. Attach with security fasteners.

I. Window and Screen Frames: Miter or cope corners the full depth of frame; weld and dress smooth.

J. Detention Bars: Fabricate flat bar perimeter frame to allow round bars to penetrate and create a secure grid. Weld round bars to back side of flat bars. Conceal detention bars within window framing.

K. Muntins: Attach muntins to perimeter framing with concealed welds.

L. Welding: Weld components to comply with referenced AWS standard.

M. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

N. Preglazed Fabrication: Preglaze window units at factory. Installation orientation of glazing to meet performance requirements. Comply with requirements in Section 088853 "Security Glazing."

O. Glazing Stops: Provide glazing stops applied with security fasteners or rivets and coordinated with glazing indicated. Finish glazing stops to match window units.

P. Weather Stripping: Factory applied.

Q. Security Screens: Secure screen to frame with security fasteners or stainless-steel rivets.

R. Security Fasteners: Fabricate detention windows using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.

2.7 METALLIC-COATED STEEL SHEET FINISHES

A. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.8 STEEL FINISHES

A. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.9 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.

1. Drive-System Type: Pinned Torx-Plus or Pinned Torx.

2.10 SECURITY SEALANTS

A. Polyurethane Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement.

B. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.

2.11 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.

C. Embedded Plate Anchors: Fabricated from mild-steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch (13-mm) diameter, headed studs welded to back of plate.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welding.

E. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B633; provide sufficient strength to withstand design pressures indicated.

F. Grout: ASTM C476.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention window connections before detention window installation.

B. In-Place-Construction Anchor Installation: Weld angle anchors to embedded anchors to match locations of detention window-frame anchors. Detach removable covers from detention window frames and set frames into opening until detention window-frame anchors contact and match embedded anchors. Weld detention window-frame anchors to embedded anchors with continuous welds or minimum 1-inch (25-mm) long welds with spacing not to exceed 18 inches (457 mm). Reinstall removable covers.

C. Built-in Frame Installation: Build-in or cast-in detention window frames or subframes integral with construction of walls. Fully engage detention window-frame anchors with wall reinforcement.

D. Grout: Fill spaces between detention windows and adjacent substrate with grout.

E. Removable Covers, Glazing Stops, and Trim: Fasten components with security fasteners.

F. Security Fasteners: Install detention windows using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials, except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.

G. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
2. Security Sealant: At inmate side, apply polyurethane or epoxy security sealant between detention window frame and adjacent construction.

H. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose.

I. Glazing: Comply with installation requirements in Section 088853 "Security Glazing" unless otherwise indicated.

J. Detention Screens: Secure screens to the interior side of window frames using security fasteners.

K. Adjust operating ventilators and hardware to provide a tight fit at contact points and weather stripping, for smooth operation and a weathertight enclosure.

3.2 FIELD QUALITY CONTROL

A. Prepare field quality-control certification endorsed by Detention Specialist that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION 085663

SECTION 086100 - ROOF WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed (nonoperable) roof windows.
2. Venting (with operable sash) roof windows.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For roof windows.

1. Include plans, elevations, sections, and installation details.
2. Include diagrams for power, signal, and control wiring for motorized operation.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE: As directed.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace roof windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Roof Window: Five or 10 years from date of Substantial Completion, as directed.

b. Insulating-Glass Units: 10 or 20 years from date of Substantial Completion, as directed.
c. Accessories and Electronic Controls: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified, with label attached to each roof window.

B. Minimum Performance Grade: AAMA/WDMA/CSA 101/I.S.2/A440 PG30, PG35, PG40, PG45 or as indicated on Drawings.

C. Thermal Transmittance: NFRC 100 maximum whole-unit U-factor of 0.55 Btu/sq. ft. x h x deg F (3.12 W/sq. m x K), 0.57 Btu/sq. ft. x h x deg F (3.24 W/sq. m x K) or 0.70 Btu/sq. ft. x h x deg F (3.97 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40 or 0.30.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.2 ROOF WINDOWS

A. Curb/Frame: Wood, Aluminum, Thermally broken aluminum, Aluminum-clad wood, Copper-clad wood, Vinyl or Manufacturer's standard.

1. Flashing: Self-flashing frame, Manufacturer's standard aluminum or Manufacturer's standard copper.

B. Sash: Wood, Aluminum, Aluminum and wood, Copper and wood, Aluminum and vinyl, Vinyl or Manufacturer's standard.

C. Insulating-Glass Units: ASTM E2190.

1. Exterior Lite: Fully tempered glass with Low-E coating.
2. Interior Lite: Laminated glass; heat-strengthened glass and 0.03-inch (0.76-mm) thick polyvinyl butyral interlayer, Fully tempered glass, Laminated glass; heat-strengthened

glass with 0.090-inch (2.29-mm-) polyvinyl butyral interlayer or Laminated glass; fully tempered glass with 0.03-inch (0.76-mm) thick polyvinyl butyral interlayer.

3. Filling: Fill space between glass lites with air or argon.

D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

E. Operating Hardware:

1. Hardware Finish: Manufacturer's standard or Match cladding appearance.
2. Operators and Controls: Gear-type rotary operator with manufacturer's standard, cable or arm control device with latching/locking mechanism.

    a. Crank-Handle Operator: Manufacturer's standard for manually operating venting units that are less than 72 inches (1800 mm) above floor.
    b. Pole Operator: Manufacturer's standard manual or motorized pole for operating venting units that are more than 72 inches (1800 mm) above floor.
    c. Remote-Control Motor Operator: Manufacturer's standard for operating venting units that are more than 72 inches (1800 mm) above floor.

        1) Electric or Solar-powered battery motor.
        2) Wireless remote or Keypad control.
        3) Provide rain sensor that automatically closes venting unit when water is detected.

3. Hinges: Continuous; Pivots, two per sash or Manufacturer's standard.

F. Exposed Finishes:

1. Exposed: Unfinished, Manufacturer's standard transparent finish in color selected by Architect from manufacturer's full range, Manufacturer's standard prime-painted finish or Manufacturer's standard opaque finish in color selected by Architect from manufacturer's full range.
2. Aluminum: Manufacturer's standard, Match Architect's sample or as selected by Architect from manufacturer's full range.
3. Copper: Manufacturer's standard, Match Architect's sample or as selected by Architect from manufacturer's full range.
4. Vinyl: Manufacturer's standard color or in color selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Insect Screens: Manufacturer's standard removable screen; aluminum or vinyl frame with mitered or coped joints and with ASTM D3656 mesh of plastic-coated glass-fiber threads. Provide frame in manufacturer's standard finish and mesh in manufacturer's standard color.

B. Blinds: In color and pattern selected by Architect from manufacturer's full range.

1. Type: Pleated; Roll up, light filtering; Roll up, blackout, Venetian or Manufacturer's standard.
2. Pole Operation: Provide manual or motorized pole for operating blinds that are more than 72 inches (1800 mm) above floor.
3. Motor Operator: Manufacturer's standard for blinds that are more than 72 inches (1800 mm) above floor.

    a. Electric or Solar-powered battery motor.
    b. Wireless remote or Keypad control.

C. Mull Kit: Manufacturer's standard for installing two units side by side or inline; finished to match roof window units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written installation instructions for installing roof windows and accessories.

B. Install roof windows square, true, and without distortion, warp, or rack of frames and sash. Securely anchor windows to structural support without impeding thermal movement.

C. Install flashing to provide a watertight and weathertight seal.

D. Separate aluminum, copper, and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials according to recommendations in ASTM E2112.

END OF SECTION 086100

SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-flashing unit skylights with integral curbs.
2. Unit skylights mounted on prefabricated or site-erected curbs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of unit skylight.

B. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

C. Samples: For each type of exposed finish required and each type of glazing.

D. Product Schedule: For unit skylights. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification data.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 PERFORMANCE REQUIREMENTS

A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Performance Class and Grade: Class R-PG 15, 20, 25, 30 or 35.
2. Performance Class and Grade: Class CW-PG 30, 35, 40, 45 or 50.
3. Certification: AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.

B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K), 0.32 Btu/sq. ft. x h x deg F (1.83 W/sq. m x K), 0.35 Btu/sq. ft. x h x deg F (2.0 W/sq. m x K), 0.50 Btu/sq. ft. x h x deg F (2.83 W/sq. m x K), 0.55 Btu/sq. ft. x h x deg F (3.12 W/sq. m x K), 0.60 Btu/sq. ft. x h x deg F (3.43 W/sq. m x K) or 0.75 Btu/sq. ft. x h x deg F (4.26 W/sq. m x K).

C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

2.3 UNIT SKYLIGHTS

A. Unit Shape and Size: As indicated, Square, 40-by-40-inch (1016-by-1016-mm) inside curb, Rectangular, 40-by-48-inch (1016-by-1220-mm) inside curb or Circular, 40-inch (1016-mm) diameter inside curb.

B. Acrylic Glazing: ASTM D4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

1. Single-Glazing Profile: Dome, 25 percent rise or Pyramid, 30-degree slope.

a. Thickness: As indicated or Not less than thickness required to exceed performance requirements.
b. Color: Colorless, transparent; White, translucent; Bronze tinted, transparent; or Gray tinted, transparent.

2. Double-Glazing Profile: Dome, 25 percent rise or Pyramid, 30-degree slope.

a. Thicknesses: As indicated or Not less than thicknesses required to exceed performance requirements.

b. Outer Glazing Color: Colorless, transparent; White, translucent; Bronze tinted, transparent; or Gray tinted, transparent.
c. Inner Glazing Color: Colorless, transparent; White, translucent; Bronze tinted, transparent; or Gray tinted, transparent.

3. Self-Ignition Temperature: 650 deg F (343 deg C) or more for plastic sheets in thickness indicated when tested according to ASTM D1929.
4. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested according to ASTM E84, and smoke density of 75 or less when tested according to ASTM D2843
5. Burning Characteristics: Tested according to ASTM D635. Class CC2, burning rate of 2-1/2 inches (64 mm) per minute or less for nominal thickness of 0.060 inch (1.5 mm) or thickness indicated for use.

C. Polycarbonate Glazing: Thermoformable, extruded monolithic sheets, UV resistant, burglar-resistance rated according to UL 972, and with average impact strength of 12 to 16 ft-lb/in. (640 to 854 J/m) of width when tested according to ASTM D256, Test Method A (Izod).

1. Single-Glazing Profile: Dome, 25 percent rise or Pyramid, 30-degree slope.

a. Thickness: As indicated or Not less than thickness required to exceed performance requirements.
b. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

2. Double-Glazing Profile: Dome, 25 percent rise or Pyramid, 30-degree slope.

a. Thicknesses: As indicated or Not less than thicknesses required to exceed performance requirements.
b. Inner Glazing Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.
c. Outer Glazing Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

3. Self-Ignition Temperature: 650 deg F (343 deg C) or more for plastic sheets in thickness indicated when tested according to ASTM D1929.
4. Smoke-Production Characteristics: Smoke-developed index of 450 or less when tested according to ASTM E84, and smoke density of 75 or less when tested according to ASTM D2843
5. Burning Characteristics: Tested according to ASTM D635. Class CC1, burning extent of 1 inch (25 mm) or less for nominal thickness of 0.060 inch (1.5 mm) or thickness indicated for use.

D. Insulating Glass: Clear, sealed units that comply with Section 088000 "Glazing," in manufacturer's standard overall thickness.

1. Exterior Lite: 6-mm clear, tinted, heat-strengthened or fully tempered glass.
2. Interior Lite: Laminated glass; two plies of 3-mm clear heat-strengthened glass with 0.030-inch (0.762-mm) clear polyvinyl butyral interlayer.
3. Interspace Content: Air or Argon.
4. Low-Emissivity Coating: Manufacturer's standard.

E. Glazing Gaskets: Manufacturer's standard or EPDM, neoprene, partially vulcanized butyl tape, or liquid-applied elastomeric sealant.

F. Integral Curb: Extruded-aluminum, Vinyl or Reinforced-thermoset-fiberglass profile, self-flashing type.

1. Extruded-Aluminum Shapes: ASTM B221 (ASTM B221M).
2. Height: As indicated, 8 inches (200 mm), 9 inches (225 mm) or 12 inches (300 mm).
3. Construction: Single or Double wall.
4. Insulation: Manufacturer's standard rigid or semirigid type.

a. Exposed Insulation: Cover face of insulation exposed to interior of building with aluminum or vinyl liner.

G. Prefabricated Curb: As specified in Section 077200 "Roof Accessories."

H. Condensation Control: Fabricate unit skylights with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.

I. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.

J. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened. Provide nonremovable fastener heads.

2.4 ALUMINUM FINISHES

A. Mill Finish: Manufacturer's standard.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, Champagne, Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish: Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.

C. Perform test for total area of each unit skylight.

D. Work will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.3 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

END OF SECTION 086200

SECTION 086300 - METAL-FRAMED SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes skylights with metal framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, and attachment details.

D. Samples: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

C. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two, Five or 10 years from date of Substantial Completion, as directed.

B. Special Aluminum-Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five, 10 or 20 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans more than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller or amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

C. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.

D. Structural-Test Performance: Metal-framed skylights tested according to ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified deflection limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

F. Air Infiltration: Metal-framed skylights with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of when tested according to ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) or 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. Condensation Resistance: Metal-framed skylights with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 or 53, as directed, when tested according to AAMA 1503.

1. Haze Factor: Greater than 90 percent when tested according to ASTM D1003.

J. Energy Performance: Provide metal-framed skylights with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K) or 0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.6 or 0.7 as determined according to NFRC 200.

2.2 METAL-FRAMED SKYLIGHTS

A. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.

B. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

C. Aluminum: Alloy and temper as recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209 (ASTM B209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

F. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

G. Concealed Flashing: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.030 inch (0.762 mm), 0.040 inch (1.016 mm) or 0.060 inch (1.524 mm) thick.

I. Framing Sealants: As recommended in writing by manufacturer or specified in Section 079200 "Joint Sealants."

J. Corrosion-Resistant Coating: Cold-applied asphalt mastic.

2.3 GLAZING

A. Glazing: As specified in Section 088000 "Glazing" or Section 088400 "Plastic Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types, as specified in Section 088000 "Glazing" or as specified in Section 088400 "Plastic Glazing."

D. Glazing Sealants: As recommended in writing by manufacturer.

2.4 FABRICATION

A. Fabricate aluminum components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

B. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

C. Reinforce aluminum components as required to receive fastener threads.

D. Factory-Glazed, Metal-Framed Skylights: Comply with requirements in Section 088000 "Glazing" or Section 088400 "Plastic Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

E. High-Performance Organic Finish: Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, and moisture migrating within skylight to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Glazing: Install glazing as specified in Section 088000 "Glazing" or Section 088400 "Plastic Glazing."

G. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m) but no greater than 1/2 inch (13 mm) over total length.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage or engage a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 086300

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.
   b. Sliding doors.
   c. Folding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC), Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC) or Architectural Openings Consultant (AOC).

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.
d. Concealed Floor Closers: Five, 10 or 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design", the DOT's "ADA Standards for Transportation Facilities", the ABA standards of the Federal agency having jurisdiction, ICC A117.1 or HUD's "Fair Housing Accessibility Guidelines", as directed.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3 or on Drawings.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.4 SELF-CLOSING HINGES AND PIVOTS: As directed.

2.5 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: BHMA A156.4.

2.6 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch (3.0-mm) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Pin-and-Barrel-Type Hinges: As directed.

C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

2.7 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) or 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.
2. Levers: Wrought, Forged or Cast.

    a. As directed.

3. Escutcheons (Roses): Wrought, Forged or Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 1 or Grade 2; Series 4000.

G. Mortise Locks: BHMA A156.13; Operational Grade 1, Security Grade 1, Operational Grade 2 or Security Grade 2; stamped steel case with steel or brass parts; Series 1000.

2.8 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 1 or Grade 2; with strike that suits frame.

B. Mortise Auxiliary Locks: BHMA A156.36; Grade 1 or Grade 2; with strike that suits frame.

C. Narrow Stile Auxiliary Locks: BHMA A156.36; Grade 1 or Grade 2; with strike that suits frame.

D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

2.9 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1 or Grade 2; with faceplate to suit lock and frame.

2.10 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

B. Delayed-Egress Electromagnetic Locks: BHMA A156.24, electrically powered, with electromagnet attached to frame and armature plate attached to door; depressing push bar for more than three seconds initiates irreversible alarm and adjustable time delay for egress. When integrated with fire alarm, fire alarm voids time delay.

2.11 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1 or Grade 2; motor or solenoid driven; with strike that suits frame.

1. Type: Bored, Mortise latchbolt, Mortise deadbolt or Mortise deadlocking latchbolt.

2.12 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, bored or mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

2.13 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

2.14 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.

2.15 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

2.16 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic Flush Bolts: BHMA A156.3, Type 25; minimum 3/4-inch (19-mm) throw; with dust-proof strikes; designed for mortising into door edge. Include wear plates.

B. Self-Latching Flush Bolts: BHMA A156.3, Type 27; minimum 3/4-inch (19-mm) throw; with dust-proof strikes designed for mortising into door edge. Include wear plates.

2.17 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

2.18 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1, Grade 1A or Grade 2 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable or Removable.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 1, Grade 2 or Grade 3 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical or E, electrical.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.19 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinders.

a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.

a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

    a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

    a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:

    a. Master key or grand master key locks to Owner's existing system.
    b. Re-key Owner's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver or Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

    a. Notation: "DO NOT DUPLICATE" or Information to be furnished by Owner.

2.20 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Multiple-Drawer Cabinet: Grade 1 or Grade 2 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
2. Wall-Mounted Cabinet: Grade 1 or Grade 2 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
3. Portable Cabinet: Grade 1 or Grade 2 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.21 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum, brass, bronze or stainless steel unless otherwise indicated.

2.22 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.23 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.24 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.25 CLOSER HOLDER RELEASE DEVICES

A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system or loss of power.

2.26 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.27 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single, floor-mounted electromagnet single or floor-mounted electromagnet double unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.

2.28 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

2.29 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.30 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.31 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

2.32 FOLDING DOOR HARDWARE

A. General: BHMA A156.14; complete sets including overhead rails, hangers, supports, bumpers, floor guides, and accessories indicated.

2.33 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch (1.3-mm) thick aluminum, brass, bronze or stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.34 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

2.35 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

2.36 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings or to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule or directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening or least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

END OF SECTION 087100

SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.
   b. Sliding doors.
   c. Folding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC), Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC) or Architectural Openings Consultant (AOC).

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.
d. Concealed Floor Closers: Five, 10 or 25 years from date of Substantial Completion, as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design", the DOT's "ADA Standards for Transportation Facilities", the ABA standards of the Federal agency having jurisdiction, ICC A117.1 or HUD's "Fair Housing Accessibility Guidelines" as directed.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3 or on Drawings.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

B. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts), Half mortise, Full surface or Half surface.
2. Bearing Material: Manufacturer's standard antifriction bearing or Ball bearing.
3. Grade: 1 (heavy weight) or 2 (standard weight).
4. Base and Pin Metal:

    a. Exterior Hinges: Stainless steel with stainless-steel pin or Brass with stainless-steel pin body and brass protruding heads.
    b. Interior Hinges: Brass with stainless-steel pin body and brass protruding heads, Steel with steel pin or Stainless steel with stainless-steel pin.
    c. Hinges for Fire-Rated Assemblies: Steel with steel pin or Stainless steel with stainless-steel pin.

5. Pins: Non-rising loose unless otherwise indicated, Maximum security or Nonremovable.

    a. Outswinging Exterior Doors: Maximum security or Nonremovable.
    b. Outswinging Corridor Doors with Locks: Maximum security or Nonremovable.

6. Tips: Flat button, Hospital, Oval, Ball, Steeple, Urn or Acorn.
7. Corners: Square, 5/32-inch (4-mm) radius, 1/4-inch (6-mm) radius or 5/8-inch (16-mm) radius.
8. Features: Raised barrel, Reverse safety stud or Safety stud.

C. Electrified Antifriction-Bearing Hinges: Full-mortise mounting.

1. Bearing Material: Manufacturer's standard antifriction bearing or Ball bearing.
2. Grade: 1 (heavy weight) or 2 (standard weight).
3. Base and Pin Metal:

    a. Exterior Hinges: Stainless steel with stainless-steel pin or Brass with stainless-steel pin body and brass protruding heads.
    b. Interior Hinges: Brass with stainless-steel pin body and brass protruding heads, Steel with steel pin or Stainless steel with stainless-steel pin.
    c. Hinges for Fire-Rated Assemblies: Steel with steel pin or Stainless steel with stainless-steel pin.

4. Pins: Non-rising loose unless otherwise indicated, Maximum security or Nonremovable.

    a. Outswinging Exterior Doors: Maximum security or Nonremovable.
    b. Outswinging Corridor Doors with Locks: Maximum security or Nonremovable.

5. Tips: Flat button, Hospital, Oval, Ball, Steeple, Urn or Acorn.
6. Corners: Square.
7. Features: Raised barrel, Reverse safety stud or Safety stud.
8. Electric Feature: Concealed electric through wires, Concealed electric through wires with monitor, Concealed electric monitor, Concealed air transfer, Concealed switch, Exposed electric switch or Exposed electric contacts.

D. Plain-Bearing Hinges: Grade 3 (standard weight).

1. Mounting: Full mortise (butts), Half mortise, Full surface or Half surface.
2. Base and Pin Metal: Brass with stainless-steel pin body and brass protruding heads or Steel with steel pin.
3. Pins: Non-rising loose unless otherwise indicated, Maximum security or Nonremovable.

    a. Outswinging Corridor Doors with Locks: Maximum security or Nonremovable.

4. Tips: Flat button, Hospital, Oval, Ball, Steeple, Urn or Acorn.
5. Corners: Square, 5/32-inch (4-mm) radius, 1/4-inch (6-mm) radius or 5/8-inch (16-mm) radius.
6. Features: Raised barrel or as directed.

E. Swing-Clear Hinges: Reversible.

1. Mounting: Full mortise (butts), Half mortise, Full surface or Half surface.
2. Bearing and Grade: Antifriction bearing, Grade 1 (heavy weight), Antifriction bearing, Grade 2 (standard weight) or Plain bearing, Grade 3 (standard weight).
3. Base Metal: Wrought brass or bronze, Stainless steel or Wrought, forged, or cast steel, or malleable iron.

4. Pins: Non-rising loose unless otherwise indicated, Maximum security or Nonremovable.

    a. Outswinging Exterior Doors: Maximum security or Nonremovable.
    b. Outswinging Corridor Doors with Locks: Maximum security or Nonremovable.

5. Tips: Flat button or Hospital.
6. Corners: Square, 5/32-inch (4-mm) radius, 1/4-inch (6-mm) radius or 5/8-inch (16-mm) radius.
7. Features: Raised barrel, Reverse safety stud, Safety stud or as directed.

2.4 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.

B. Spring Hinges: Grade 1 or Grade 2; wrought steel, with torsion spring.

1. Type: Single or Double acting.
2. Mounting: Full mortise (butts), Half mortise, Full surface or Half surface.

2.5 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: BHMA A156.4.

B. Center-Hung Pivot Sets: Grade 1.

1. Top Pivots: Walking-beam type with retractable pin and oil-impregnated bronze bearing; mortised into door and frame.
2. Bottom Pivots: Surface floor mounted, Recessed in floor in cement case, Mortised into jamb, and mortised into door.

    a. Bearing: Thrust ball or Needle.

3. Base Metal: Brass, Bronze or Steel.

C. Offset Pivot Sets: Grade 1 or Grade 2.

1. Offset: 3/4 inch (19 mm) or 1-1/2 inches (38 mm).
2. Top Pivot: Full-mortise, Half-surface or Full-surface mounting; walking-beam type with retractable pin and oil-impregnated bronze bearing.

    a. Knuckle: Standard or Asylum type.
    b. Feature: With screw holes designed to straddle lead in center of lead-lined door.

3. Bottom Pivot: Surface floor mounted, Recessed in floor in cement case, Mortised into jamb, and mortised into door; with thrust ball or needle bearing.
4. Base Metal: Brass, Bronze, Stainless steel or Steel.

D. Offset Intermediate Pivots: Grade 1; for use with offset pivot sets; with oil-impregnated bronze bearings.

1. Mounting: Full mortise, 3/4-inch (19-mm) offset, Full mortise, 1-1/2-inch (38-mm) offset, Half mortise, Half surface or Full surface.
2. Knuckle: Standard or Asylum type.
3. Feature: With screw holes designed to straddle lead in center of lead-lined door.
4. Electric Feature: Concealed monitoring, Concealed power transfer or Concealed power transfer for use with electrical panic devices and locks.
5. Base Metal: Brass, Bronze, Stainless steel or Steel.

2.6 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch (3.0-mm) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Pin-and-Barrel-Type Hinges:

1. Grade: 1-150, 1-300, 1-600, 2-150, 2-300, 2-600, 3-150 or 3-300.
2. Exterior Hinges: Stainless steel.
3. Interior Hinges: Stainless steel, Steel or Aluminum.
4. Hinges for Fire-Rated Assemblies: Stainless steel with steel fire pins to hold fire-rated doors in place if required by tested listing or Steel.
5. Type: Concealed leaf, Swing clear, Full surface with removable continuous caps over fasteners, Half mortise, concealed door leaf and with removable continuous cap over fasteners on jamb leaf or Half surface, concealed jamb leaf and with removable continuous cap over fasteners on door leaf.
6. Electric Feature: Electric monitoring switch, Electric through wires and monitor, Electric through wires, Concealed power transfer or Exposed power transfer contact switch.

C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Grade: 1-150, 1-300, 1-600, 2-150, 2-300, 2-600, 3-150 or 3-300.
2. Hinges for Fire-Rated Assemblies: With steel fire pins to hold fire-rated doors in place if required by tested listing.
3. Mounting: Concealed leaf, Swing clear, Full surface, with removable continuous caps over fasteners or Half surface, concealed jamb leaf and with removable continuous cap over fasteners on door leaf.
4. Electric Feature: Electric monitor, Electric through wires and monitor, Electric through wires, Electric power transfer, Exposed switch, Exposed contact or Removable electric through wires.

2.7 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm) or 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.
2. Levers: Wrought, Forged or Cast.

    a. Construction: Solid, Tube, Freewheeling vandal resistant or Breakaway vandal resistant.

3. Escutcheons (Roses): Wrought, Forged or Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 1 or Grade 2; Series 4000.

G. Mortise Locks: BHMA A156.13; Operational Grade 1, Security Grade 1, Operational Grade 2 or Security Grade 2; stamped steel case with steel or brass parts; Series 1000.

2.8 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 1 or Grade 2; with strike that suits frame.

1. Backset: 2-3/8 inches (60 mm) or 2-3/4 inches (70 mm).
2. Material: Aluminum, Brass, Bronze, Stainless steel or Zinc alloy.
3. Deadlatches: Deadlocking latchbolt operated by key either side, key outside and turn inside or turn inside with no cylinder.
4. Deadlocks: Deadbolt operated by key either side, key outside and turn inside, turn inside with no cylinder or key outside, no trim inside.

B. Mortise Auxiliary Locks: BHMA A156.36; Grade 1 or Grade 2; with strike that suits frame.

1. Backset: 2-3/4 inches (70 mm).
2. Material: Aluminum, Brass, Bronze, Stainless steel or Zinc alloy.

3. Deadlocks: Deadbolt operated by key either side, outside and turn inside or one side.
4. Deadlatches: Latchbolt and auxiliary deadlatch operated by key either side, outside and turn inside.
5. Deadlocks for Sliding Doors: Expanding- or interlocking-type deadbolt operated by key either side, outside and turn inside or one side.
6. Deadlatches for Sliding Doors: Hook-type latchbolt operated by key either side or outside and handle inside.

C. Narrow Stile Auxiliary Locks: BHMA A156.36; Grade 1 or Grade 2; with strike that suits frame.

1. Backset: 0.98 inch (25 mm), 1.125 inches (29 mm), 1.25 inches (32 mm), 1.5 inches (38 mm), 1.75 inches (44 mm), 2 inches (51 mm), 2.25 inches (57 mm) or 2.5 inches (64 mm).
2. Strike: Flat, Flat with extra-long lip, Radius, Radius with weatherstrip or Bevel.
3. Case Material: Steel or Stainless steel.
4. Armored Front and Strike Material: Aluminum, Brass, Bronze or Stainless steel.
5. Deadlock: Deadlocking bolt.

    a. Operation: Key both sides or outside and operating trim inside.
    b. Door Application: Swinging or Sliding door.

6. Deadlatch: Latchbolt with auxiliary deadlatch operated by key outside and paddle or lever inside; for single swinging doors.
7. Multipoint Lock: Deadlocking bolt for pairs of swinging doors.

    a. Operation: Key both sides or outside and turn, lever, or knob inside.
    b. Type: Two or Three point.

8. Latch/Lock: Deadbolt and latchbolt; both operated by key both sides; inside handle operates only latchbolt.

D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

1. Auxiliary Lock Configuration: Deadbolt, Deadlocking latch or Deadlocking rim latch.
2. Override: By key cylinder.

2.9 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1 or Grade 2; with faceplate to suit lock and frame.

1. Material: Steel, Stainless steel or Zinc-aluminum alloy.
2. Mounting: Mortised, Semirim mounted or Rim mounted.
3. Fire-Rated Door Assemblies: Use fail-secure electric strikes with fire-rated devices.

4. Monitoring: Mechanical latchbolt, Infrared latchbolt, Mechanical strike or Infrared strike.
5. Features: Lip extension kit or Open-back strike.

2.10 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

1. Direct-Hold Type: Lock mounted on bottom of header; strike flush mounted on door push side, face of header; strike angle mounted on door pull side or side of jamb; strike flush mounted on door push side.
2. Shear Type: Lock mounted on face of header; strike angle mounted on door, mortised in header; strike mortised in top of door, mortised in jamb; strike mortised in edge of door, mortised in bottom of door; strike mortised in floor or mortised in floor; strike mortised in bottom of door.
3. Strength Ranking: 1500 lbf (6672 N), 1000 lbf (4448 N) or 500 lbf (2224 N).
4. Inductive Kickback Peak Voltage: Not more than 53 or 0 V.
5. Residual Magnetism: Not more than 4 lbf (18 N) or 0 lbf (0 N) to separate door from magnet.
6. Features:

    a. Magnetic bond sensor.
    b. Continuous housing for full width of door.
    c. Continuous housing for full height of door.
    d. Single LED indicators.
    e. Double LED indicators.
    f. Adjustable time delay with automatic relock.
    g. Integral door position switch.

B. Delayed-Egress Electromagnetic Locks: BHMA A156.24, electrically powered, with electromagnet attached to frame and armature plate attached to door; depressing push bar for more than three seconds initiates irreversible alarm and adjustable time delay for egress. When integrated with fire alarm, fire alarm voids time delay.

1. Grade: Security grade, activated from secure side of door by initiating device or Movement grade, activated by door movement as initiating device.

2.11 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1 or Grade 2; motor or solenoid driven; with strike that suits frame.

1. Type: Bored, Mortise latchbolt, Mortise deadbolt or Mortise deadlocking latchbolt.

2.12 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, bored or mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. Actuating Device: Digital keypad, Magnetic-stripe card reader or Smart-card reader.

    a. Card: Manufacturer's standard, 0.030-inch (0.76-mm) thick PVC or polyester or Custom.
    b. Accessory: Card encoder and software.

2. Faceplate Material: Wrought brass, Wrought bronze or Stainless steel.
3. Lock Trim: Lever, Knob or Match trim specified for mechanical locks.
4. Function: Latch with Deadbolt, Latch without or Deadbolt without key.

2.13 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

B. Exit Locks: Surface mounted; battery powered, housed in metal case; with manufacturer's standard strike that suits frame; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN - ALARM WILL SOUND."

1. Single-Door or Pairs-of-Door Type: Activated by arm, push plate, or paddle or horizontal bar.
2. Features:

    a. Low-battery alert.
    b. Outside key control.
    c. Audible alarm that sounds when unauthorized use of door occurs.
    d. Silent alarm with remote signal capability for connection to remote indicating panel.
    e. Strike: Surface or Mortise.

C. Standalone Exit Alarms: Surface mounted on door or Mounted separate from door and activated by door movement switch.

1. Features:

    a. Low-battery alert.
    b. Outside key control.
    c. Audible alarm that sounds when unauthorized use of door occurs.
    d. Automatic rearming after authorized use, with adjustable time delay.
    e. Remote signal capability for connection to remote indicating panel.

2.14 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.

B. Half-Round Surface Bolts: Grade 1 or Grade 2, 6-inch (152-mm) polished-brass or burnished-steel, half-round rod and knob; minimum 7/8-inch (22-mm) throw; with universal strike.

C. Interlocking Surface Bolts: Grade 1 or Grade 2, 6-inch (152-mm) extruded-brass or aluminum, interlocking track and rod; minimum 15/16-inch (24-mm) throw; with universal or mortise strike.

D. Fire-Rated Surface Bolts: Grade 1 or Grade 2, 8-inch (203-mm) steel bolt with 2 steel guides; minimum 1-inch (25-mm) throw; listed and labeled for use in fire-rated assemblies; with universal strike.

2.15 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

B. Manual-Extension Flush Bolts: Grade 1 or Grade 2, fabricated from extruded brass or aluminum, with 12-inch (305-mm) rod actuated by flat lever.

1. Strike: Matching or Dustproof.
2. Fire Rated: Listed and labeled for use in fire-rated assemblies.

C. Top-Bolt Extension Rod Length: As required to locate operating mechanism at not more than 72 inches (1829 mm) above the finished floor at all times.

D. Dustproof Strikes: Locking type, Grade 1, polished wrought brass, with 3/4-inch (19-mm) diameter, spring-tension plunger.

2.16 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic Flush Bolts: BHMA A156.3, Type 24; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge. Include wear plates.

B. Self-Latching Flush Bolts: BHMA A156.3, Type 27; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge. Include wear plates.

C. Automatic Flush Bolts: Grade 1 or Grade 2, fabricated from steel and brass components, with spring-activated bolts that automatically retract when active leaf is opened and that automatically engage when active door depresses bolt trigger. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.

1. Strikes: Matching or Dustproof.
2. Fire Rated: Listed and labeled for use in fire-rated assemblies.

D. Self-Latching Flush Bolts: Grade 1 or Grade 2, fabricated from steel and brass components, with spring-activated bolts that automatically engage when active door depresses trigger. Bolts

are manually retracted by a slide in the bolt face. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.

1. Strikes: Matching or Dustproof.
2. Fire Rated: Listed and labeled for use in fire-rated assemblies.

E. Dustproof Strikes: Locking type, Grade 1, polished wrought brass, with 3/4-inch (19-mm) diameter, spring-tension plunger.

2.17 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

D. Rim Exit Devices: Grade 1 or Grade 2.

1. Type: 1, rim; 4, narrow stile or 28, incorporating a deadbolt.
2. Actuating Bar: Cross bar, Push pad or Narrow-stile push pad.
3. Material: Brass, Bronze, Stainless steel, Aluminum or Wrought steel.
4. Electrified Features:

    a. Push pad monitor switch.
    b. Double push pad monitor switch.
    c. Electric locking and unlocking.
    d. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
    e. Delayed egress.
    f. Alarm.

E. Mortise Exit Devices: Grade 1 or Grade 2.

1. Type: 3 or 10, narrow stile.
2. Actuating Bar: Cross bar, Push pad or Narrow-stile push pad.
3. Material: Brass, Bronze, Stainless steel, Aluminum or Wrought steel.
4. Electrified Features:

    a. Push pad monitor switch.
    b. Double push pad monitor switch.
    c. Electric locking and unlocking.
    d. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
    e. Delayed egress.
    f. Alarm.

F. Surface Vertical-Rod Exit Devices: Grade 1 or Grade 2.

1. Type: 2 or 5, narrow stile.
2. Actuating Bar: Cross bar, Push pad or Narrow-stile push pad.
3. Material: Brass, Bronze, Stainless steel, Aluminum or Wrought steel.
4. Configuration: Top and bottom rods or Top rod.
5. Electrified Features:

    a. Push pad monitor switch.
    b. Double push pad monitor switch.
    c. Electric locking and unlocking.
    d. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
    e. Delayed egress.
    f. Alarm.

G. Concealed Vertical-Rod Exit Devices: Grade 1 or Grade 2.

1. Type: 6, narrow stile, 7, for wood doors or 8, for metal doors.
2. Actuating Bar: Cross bar, Push pad or Narrow-stile push pad.
3. Material: Brass, Bronze, Stainless steel, Aluminum or Wrought steel.
4. Configuration: Top and bottom rods or Top rod.
5. Electrified Features:

    a. Push pad monitor switch.
    b. Double push pad monitor switch.
    c. Electric locking and unlocking.
    d. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
    e. Delayed egress.
    f. Alarm.

H. Combination Exit Devices: Grade 1 or Grade 2.

1. Type: 9, rim and surface vertical rod, 11, mortise and surface vertical rod or 12, mortise and concealed vertical rod.
2. Actuating Bar: Cross bar, Push pad or Narrow-stile push pad.
3. Material: Brass, Bronze, Stainless steel, Aluminum or Wrought steel.
4. Electrified Features:

    a. Push pad monitor switch.
    b. Double push pad monitor switch.
    c. Electric locking and unlocking.
    d. Fail-secure electric latch retraction (dogging) that engages latch when fire-alarm system is activated.
    e. Delayed egress.
    f. Alarm.

I. Automatic Latching Two-Point Bolts: Grade 1.

1. Type: 23, concealed or 24, surface.

2. Material: Brass, Bronze or Stainless steel.

J. Extension Flush Bolt Sets: BHMA A156.3; Grade 1.

1. Type: 25, automatic or 27, self-latching.
2. Material: Brass, Bronze or Stainless steel.

K. Electronic Exit Bars: Nonlatching electronic actuating (releasing) device activated by an adjustable capacitance sensor and with no moving parts; listed and labeled as panic exit hardware. Fabricate bar from extruded aluminum and provide door and frame transfer device and 16 feet (4.9 m) of cord to route wiring off the door frame.

L. Extruded-Aluminum Removable Mullions: With malleable-iron top and bottom retainers, and prepared for strikes as follows:

1. Strikes: Two standard recessed strikes or One standard and one electric strike with disconnect for wiring harness at top of mullion.

M. Tube-Steel Removable Mullions: With malleable-iron top and bottom retainers, and prepared for strikes as follows:

1. Strikes: Two standard recessed strikes or One standard and one electric strike with disconnect for wiring harness at top of mullion.

N. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Use mullions only with exit devices for which they have been tested.

O. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

1. Operation: Rigid, Movable or Movable with monitor switch.

P. Exit Device Outside Trim: Lever, Lever with cylinder, Knob, Knob with cylinder, Pull, Pull with cylinder or Thumb turn with cylinder; material and finish to match locksets unless otherwise indicated.

1. Match design for lock trim unless otherwise indicated.

Q. Through-Bolt Fasteners: For exit devices and trim on metal doors, non-fire-rated wood doors or fire-rated wood doors.

2.18 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1, Grade 1A or Grade 2 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable or Removable.
2. Number of Pins: Five, Six or Seven.
3. Lock Type: Mortise, Rim or Bored-lock type.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 1, Grade 2 or Grade 3 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical or E, electrical.
2. Number of Pins: Six or Seven.
3. Lock Type: Mortise, Rim or Bored-lock type.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.19 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinders.

   a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.

   a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

   a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

   a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:

   a. Master key or grand master key locks to Owner's existing system.
   b. Re-key Owner's existing master key system into new keying system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver or Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE" or Information to be furnished by Owner.

2.20 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Multiple-Drawer Cabinet: Grade 1 or Grade 2 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
2. Wall-Mounted Cabinet: Grade 1 or Grade 2 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
3. Portable Cabinet: Grade 1 or Grade 2 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.21 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum, brass, bronze or stainless steel unless otherwise indicated.

B. Flat Push Plates: With square corners and beveled edges; secured with exposed screws.

1. Thickness: 0.050 inch (1.3 mm) or 1/8 inch (3.2 mm).
2. Size: 4 inches wide by 16 inches high (102 mm wide by 406 mm high).

C. Push-Pull Plates: With square corners, beveled edges, and raised integral lip; secured with exposed screws.

1. Thickness: 1/8 inch (3.2 mm).
2. Size: 3-1/2 inches wide by 15-3/4 inches high (89 mm wide by 400 mm high).

D. Straight Door Pulls:

1. Type: 3/4-inch (19-mm) constant-diameter, variable-diameter, flattened-round or hospital-type pull.
2. Mounting: Surface applied with concealed fasteners, Through bolted with oval-head machine screws and countersunk washers or Back to back with threaded sleeves.
3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.
4. Overall Length: 9 inches (229 mm).

E. Offset Door Pulls: 1-inch (25-mm) constant-diameter pull.

1. Mounting: Surface applied with concealed fasteners, Through bolted with oval-head machine screws and countersunk washers or Back to back with threaded sleeves.
2. Offset: 2 inches (51 mm).
3. Minimum Clearance: 2-1/4 inches (57 mm) from face of door.
4. Overall Length: 9 inches (229 mm).

F. Flush Door Pulls: Mortised 1/2 inch (13 mm) deep; secured with screws.

1. Shape: Rectangular with rectangular recess.
2. Size: 3-1/2 inches wide by 4-3/4 inches high (89 mm wide by 121 mm high).

G. Straight Pull-Plate Door Pulls: Pull fixed to 0.050-inch (1.3-mm) thick plate, 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges.

1. Type: 3/4-inch (19-mm) constant-diameter, variable-diameter, flattened-round or hospital-type pull.
2. Mounting: Surface applied with concealed fasteners, Through bolted with oval-head machine screws and countersunk washers or Back to back with threaded sleeves.
3. Minimum Pull Clearance: 1-1/2 inches (38 mm) from face of door.
4. Overall Pull Length: 9 inches (229 mm).

H. Offset Push-Pull Door Pulls: Pull fixed to 0.050-inch (1.3-mm) thick plate, 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges.

1. Pull Diameter: 1-inch (25-mm) constant diameter.
2. Pull Offset: 2 inches (51 mm).
3. Minimum Pull Clearance: 2-1/4 inches (57 mm) from face of door.
4. Overall Pull Length: 9 inches (229 mm).

I. Single Push Bar: Horizontal-bar type.

1. Mounting: Surface applied with concealed fasteners or Through bolted with oval-head machine screws and countersunk washers.
2. Shape and Size: 1-inch (25-mm) constant-diameter round bar or Minimum 3/8-by-1-1/4-inch (10-by-32-mm) flat bar.
3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.

J. Double Pull Bar: Two horizontal bars connected by matching vertical pull bar and spaced at 8 inches (200 mm) o.c.

1. Mounting: Surface applied with concealed fasteners or Through bolted with oval-head machine screws and countersunk washers.
2. Shape and Size: 1-inch (25-mm) constant-diameter round bars or Minimum 3/8-by- 1-1/4-inch (10-by-32-mm) flat bars.
3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.

2.22 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Flat Overlapping Astragals: BHMA A156.22; flat primed steel, zinc-plated steel, aluminum, stainless-steel or brass metal bar, surface mounted on face of door with screws; minimum 1/8 inch (3.2 mm) thick by 2 inches (51 mm) wide by full height of door.

D. Rigid, Housed Astragals: BHMA A156.22; gasket material held in place by metal housing; fastened to face of door with screws.

1. Gasket Material: Closed-cell sponge silicone, Closed-cell sponge neoprene, Neoprene or Silicone bulb.
2. Housing Material: Aluminum or Copper alloy (brass or bronze).

E. Overlapping-with-Gasket Astragals: BHMA A156.22; T-shaped metal, surface mounted on edge of door with screws.

1. Base Metal: Primed steel, Zinc-plated steel, Aluminum or Stainless steel.
2. Gasket Material: Vinyl, Silicone, Sponge neoprene, Brush pile or Polypropylene.

2.23 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

B. Cast-Aluminum Surface Closers: Grade 1 or Grade 2; Traditional type with mechanism enclosed in cast-aluminum alloy shell.

1. Mounting: Hinge side, Opposite hinge side, Parallel arm or Bracket.
2. Type: Regular arm, Fusible-link holder arm, Two-point hold-open arm or Delayed action closing.
3. Backcheck: Factory preset or adjustable, effective between 60 and 85 degrees of door opening.

C. Surface Closer without Cover: Grade 1 or Grade 2; Modern type.

1. Mounting: Hinge side, Opposite hinge side, Parallel arm, Bracket, Hinge side top jamb or Opposite side top jamb.
2. Type: Regular arm, hold open, fusible-link holder arm, Slide track arm, Dead stop, Dead stop hold open or Delayed action closing.

3. Backcheck: Factory preset or adjustable, effective between 60 and 85 degrees of door opening.
4. Closing Power Adjustment: At least 50, 35 or 15 percent more than minimum tested value.

D. Surface Closer with Cover: Grade 1 or Grade 2; Modern type with mechanism enclosed in cover.

1. Mounting: Hinge side, Opposite hinge side, Parallel arm, Bracket, Hinge side, top jamb or Opposite side, top jamb.
2. Type: Regular arm, hold open, Fusible-link holder arm, Slide track arm, Dead stop, Dead stop hold open or Delayed action closing.
3. Backcheck: Factory preset or adjustable, effective between 60 and 85 degrees of door opening.
4. Cover Material: Aluminum, Plated steel or Molded plastic.
5. Closing Power Adjustment: At least 50, 35 or 15 percent more than minimum tested value.

2.24 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

B. Concealed-in-Door Closer: Grade 1 or Grade 2; mortised into top rail of minimum 1-3/4-inch (44-mm) thick doors and track mortised into head frame; with double lever arm indicated.

1. Type: Surface shoe or Mortised soffit plate.
2. Arm: Regular or Hold open.
3. Closing Power Adjustment: At least 50, 35 or 15 percent more than minimum tested value.

C. Concealed Overhead Closer: Grade 1 or Grade 2; mortised into head frame; with cast-metal body and exposed cover plate.

1. Type: Exposed arm with surface shoe, single acting, Concealed arm and track, butt or pivot hung, single acting, Concealed arm and track, center pivoted, single acting or Concealed arm and track, center pivoted, double acting.
2. Arm: Regular, Automatic hold open, manually selected hold open or Fusible-link holder arm.
3. Track: Regular, Automatic hold open or manually selected hold open.
4. Cover Plate Material: Aluminum or Plated steel.
5. Backcheck: Factory preset or Adjustable.
6. Closing Power Adjustment: At least 50 or 35 percent more than minimum tested value.

D. Concealed Floor Closer: Grade 1 or Grade 2; with cement case and cast-iron closer body case and top pivot.

1. Closer Type: Center pivoted; include top pivot, offset pivoted; include top pivot or Independently hung.
2. Door-Swing Type: Single or Double acting.
3. Fire Rated: Listed for use in labeled fire-rated assemblies where indicated.
4. Function: Regular, Automatic hold open, manually selected hold open or Delayed action closing.
5. Backcheck: Factory preset or Adjustable.
6. Closing Power Adjustment: At least 50 or 35 percent more than minimum tested value.
7. Case Depth: Regular, 4 inches (100 mm) or Shallow, 2 inches (50 mm).
8. Floor Plates: Provide flush cover plates matching door hardware finish or recessed floor plates with insert of floor finish material and extended closer spindle to accommodate thickness of floor finish unless thresholds are indicated.

    a. Material: Aluminum or Plated steel.

2.25 CLOSER HOLDER RELEASE DEVICES

A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system or loss of power.

1. Type: Single-point hold open, Multiple-point hold open or Free-swinging release.
2. Mounting: Surface mounted on face of door, Surface mounted on face of top jamb, Surface mounted on stop, mortised into top rail of door, mortised into top jamb or Recessed into floor.
3. Features:

    a. Adjustable backcheck.
    b. Integral smoke detector.
    c. Adjustable spring power.
    d. Adjustable hold-open manual release force.

2.26 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

B. Rigid-Type Floor Stop: Grade 1 or Grade 2; with rubber bumper.

1. Installation: Surface-screw or Expansion-shield installation.

C. Dome-Type Floor Stop: Grade 1 or Grade 2; with minimum 1-inch (25-mm) high bumper for doors without threshold and 1-3/8-inch (35-mm) high bumper for doors with threshold.

1. Provide with extruded-aluminum riser for carpet installations.

D. Combination Floor Stop and Holder: Grade 1 or Grade 2.

1. Installation: Surface-screw or Expansion-shield installation.
2. Hold Open: Semiautomatic or Automatic with release by pushing door.

E. Manual Combination Floor Stop and Holder: Grade 1 or Grade 2; 3-1/2 inches (89 mm) long, with holder, keeper, and rubber bumper.

1. Installation: Surface-screw or Expansion-shield installation.

F. Wall Bumpers: Grade 1 or Grade 2; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation.

1. Bumper Configuration: Convex or Concave.

G. Roller-Type Wall Bumpers: Grade 1 or Grade 2; minimum 4-3/8-inch (111-mm) projection from wall; for surface-screw application.

2.27 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single, floor-mounted electromagnet single or floor-mounted electromagnet double unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.

2.28 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

B. Overhead Concealed Slide Holders: Type 1; Grade 1 or Grade 2; hold open and release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for doors opening 110 degrees.

1. Door Swing Type: Single or Double acting.

C. Overhead Concealed Slide Stops: Type 1; Grade 1 or Grade 2; release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for doors opening 110 degrees.

1. Door Swing Type: Single or Double acting.

D. Overhead Surface-Mounted Slide Holders: Type 2; Grade 1 or Grade 2; hold open and release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

E. Overhead Surface-Mounted, Concealed Slide Stops: Type 2; Grade 1 or Grade 2; release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

F. Overhead Concealed, Friction Slide Holders: Type 4; Grade 1 or Grade 2; with frictional element held under adjustable pressure, free-acting shoulder pivots, and shock absorber; for doors opening 110 degrees.

1. Door Swing Type: Single or Double acting.

G. Overhead Concealed, Nonfriction Slide Stops: Type 4; Grade 1 or Grade 2; with nonfrictional element held under adjustable pressure and shock absorber; for single or double-acting doors opening 110 degrees.

H. Overhead Concealed, Nonfriction Slide Holders: Type 4; Grade 1 or Grade 2; with nonfrictional element held under adjustable pressure, automatic hold-open, and shock absorber; for doors opening 110 degrees.

1. Door Swing Type: Single or Double acting.

I. Overhead Surface-Mounted, Friction Slide Holders: Type 5; Grade 1 or Grade 2; with frictional element held under adjustable pressure, free-acting shoulder pivots, and shock absorber; for single-acting doors opening 110 degrees.

J. Overhead Surface-Mounted, Nonfriction Slide Stops: Type 5; Grade 1 or Grade 2; with nonfrictional element held under adjustable pressure and shock absorber; for single-acting doors opening 110 degrees.

K. Overhead Surface-Mounted, Nonfriction Slide Holders: Type 5; Grade 1 or Grade 2; with nonfrictional element held under adjustable pressure, automatic hold-open, and shock absorber; for single-acting doors opening 110 degrees.

2.29 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

C. Adhesive-Backed Perimeter Gasketing: Vinyl bulb, Sponge silicone, Silicone, Neoprene bulb or Sponge neoprene gasket material applied to frame rabbet with self-adhesive.

D. Rigid, Housed, Perimeter Gasketing: Sponge silicone, Sponge neoprene, Silicone bulb, Polyurethane bulb, Vinyl bulb, Vinyl brush, Nylon brush or Thermoplastic elastomer gasket material held in place by housing; fastened to frame stop with screws.

1. Housing Material: Aluminum, (Brass or bronze) or Stainless steel.

E. Adjustable, Housed, Perimeter Gasketing: Screw-adjustable, sponge silicone, sponge neoprene, silicone bulb, polyurethane bulb, vinyl bulb, vinyl brush, nylon brush or thermoplastic elastomer gasket material held in place by housing; fastened to frame stop with screws.

1. Housing Material: Aluminum, (Brass or bronze) or Stainless steel.

F. Overlapping Astragals for Meeting Stiles: EPDM strip, Vinyl strip or Nylon brush gasket material held in place by housing and overlapping when doors are closed; mounted to face of meeting stile with screws.

1. Housing Material: Aluminum or Bronze.
2. Mounting: Surface mounted on face of each or one door.

G. Meeting Astragals for Meeting Stiles: Silicone bulb, Neoprene bulb, Vinyl bulb, Nylon brush, Brush pile or Thermoplastic elastomer gasket material held in place by housing; mounted with screws.

1. Housing Material: Aluminum or Bronze.
2. Mounting: Surface mounted on face of each door, Surface mounted on face of one door, Semimortised into edge of each door, Semimortised into edge of one door, mortised into edge of each door or Mortised into edge of one door.

H. Adjustable Astragals for Meeting Stiles: Screw-adjustable, silicone, neoprene, vinyl, vinyl-covered magnet, brush pile or thermoplastic elastomer gasket material held in place by housing; mounted with screws.

1. Housing Material: Aluminum or Bronze.
2. Mounting: Surface mounted on face, Semimortised into edge or Mortised into edge of each door.

I. Door Sweeps: Neoprene, Vinyl, Nylon brush, Polyurethane or Silicone gasket material held in place by flat housing or flange; surface mounted to face of door with screws.

1. Housing or Flange Material: Aluminum or Bronze.

J. Door Shoes: Vinyl, Thermoplastic elastomer, Neoprene or Brush pile gasket material held in place by housing; mounted to bottom edge of door with screws.

1. Housing Material: Aluminum or Bronze.
2. Extended Housing: One side or both sides of door.
3. Mounting: Surface mounted on or mortised into bottom edge of door.

K. Automatic Door Bottoms: Sponge neoprene, Sponge silicone, Thermoplastic elastomer or Nylon brush gasket material held in place by housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

1. Housing Material: Aluminum, Bronze or Aluminum lined with 0.047-inch (1.2-mm) thick lead.
2. Mounting: Semimortised into bottom or Mortised into bottom of door.
3. Type: Low-closing-force type for doors required to meet accessibility requirements.

2.30 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

B. Compressing-Top Thresholds: Metal member with compressible vinyl seal on top of threshold that seals against bottom of door; and base metal of aluminum, extruded bronze or stainless steel.

C. Saddle Thresholds:

1. Type: Smooth top, Fluted top, Fluted top and offset, Thermal break and fluted top, Applied gasketed stop and fluted top, Carpet separator with fluted top or Fluted top, barrier free.
2. Base Metal: Aluminum, Extruded bronze or Stainless steel.

D. Half-Saddle Thresholds: Fluted-top metal member; and base metal of aluminum or extruded bronze.

E. Interlocking Thresholds: Fluted-top metal member with integral lip designed to engage a hook strip applied to door.

1. Type: Single lip, Double lip, Double-lip water return, Double-lip water return with aluminum pan or Single lip with thermal barrier.
2. Base Metal: Aluminum or Extruded bronze.

F. Latching/Rabbeted Thresholds:

1. Type: Fluted, Smooth or Offset with fluted top.
2. Base Metal: Aluminum or Extruded bronze.

G. Latching/Rabbeted Thresholds with Gasket: Fluted-top metal member with gasket.

1. Type: Offset or Thermal barrier.
2. Base Metal: Aluminum or Extruded bronze.
3. Gasket Material: Vinyl, Silicone, Neoprene, Brush pile or Closed-cell sponge neoprene.

H. Latching/Rabbeted Panic Thresholds:

1. Type: Fluted, barrier free or Fluted with gasket top.
2. Base Metal: Aluminum or Extruded bronze.

I. Plate Thresholds: Solid metal plate.

1. Top Surface: Fluted with slip-resistant abrasive.
2. Base Metal: Aluminum, Extruded brass or bronze or Stainless steel.

J. Ramped Thresholds: Modular, interlocking, sloped, fluted-top metal assemblies with closed return ends; 1:12 slope.

1. Top Surface: Fluted with slip-resistant abrasive.
2. Base Metal: Aluminum or Extruded bronze.

K. Saddle Thresholds for Floor Closers: Fluted top.

1. Type: A, for center-hung doors; ends not mitered; B, for offset-hung doors; ends not mitered; C, for center-hung doors; ends mitered; or D, for offset-hung doors; ends mitered.
2. Base Metal: Aluminum or Extruded bronze.

2.31 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

B. Horizontal Sliding Door Hardware: Grade 1; rated for minimum door weight of 240 lb (109 kg), 320 lb (145 kg), 450 lb (205 kg), 560 lb (254 kg), 640 lb (290 kg), 800 lb (363 kg), 1000 lb (455 kg) or 1500 lb (681 kg).

1. Material: Wrought steel, Galvanized steel or anodized aluminum.
2. Rail: Box without mounting brackets, Box with attached mounting brackets, Box with attached flashing, Round without mounting brackets or Round with attached mounting brackets.
3. Rail Supports: Single sidewall, Double sidewall, Triple sidewall, Single overhead, Single overhead parallel, Single overhead cross-ear, Double overhead cross-ear or Triple overhead cross-ear style.

    a. Provide intermediate-, end-, and splice-type track supports as required by rail configuration and door weight indicated.

4. Hanger Configuration: Four-wheel truck, hanger assembly with top mounting plate, hanger assembly with drop bolt, hanger assembly with single drop strap or hanger assembly with double drop strap.

    a. Wheel Assembly: Steel wheels with ball bearings.

5. Accessories:

    a. Continuous bottom guide.
    b. Guide rail and guide rail brackets as required by rail configuration.
    c. Bow handle, minimum 6 inches (150 mm) in overall length.
    d. Flush pull, minimum 4 by 5-1/2 by 3/4 inch (100 by 140 by 19 mm), mortised into door.
    e. Cane bolt, minimum 1/2-inch (13-mm) diameter by 12 inches (305 mm) long.
    f. Stay roller, minimum 2-inch (50-mm) diameter wheel.
    g. Floor center stop of cast iron.
    h. End guide and stop.
    i. Parallel door floor guides.
    j. Door stop.
    k. Sliding door latch.
    l. Bumper shoe, minimum 0.0598-inch (1.5-mm) thickness.
    m. Cremone bolt with lever handle, minimum 1/2-inch (13-mm) diameter oval or round rod, and rod guides at 24 inches (610 mm) o.c.

n. Top spring bolt, minimum 6 inches (150 mm) or 8 inches (200 mm); malleable iron and with angle or surface strike and 24-inch (610-mm) chain.
o. Foot bolt minimum 6 inches (150 mm) or 8 inches (200 mm); wrought steel, cast iron, or malleable iron.

C. Bypassing Sliding Door Hardware: Rails and door hardware that allow vertical adjustment and rated for doors weighing up to 120 lb (54 kg) Grade 1, 80 lb (36 kg) Grade 1 or 40 lb (18 kg) Grade 2.

1. Rail Material: Galvanized wrought steel or Extruded aluminum.
2. Rail Configuration: V-grooved double leg, V-grooved double leg with fascia or I-beam.
3. Mounting: Top hung or Bottom supporting with overhead guide.
4. Wheel Assembly: Two wheel or four wheel, with roller bearings.
5. Pulls: Flush, mortised into door, Cast, forged, or extruded brass or bronze surface-applied type, wrought brass or bronze edge type, mortised into edge of door, Sliding door latch or Sliding door lock with emergency release.
6. Accessories:

a. Bumper stops; wrought steel.
b. Floor guides.

D. Pocket Sliding Door Hardware: Grade 1; rated for doors weighing up to 120 lb (54 kg) or 80 lb (36 kg), overhead box rails and door hardware that allows vertical adjustment.

1. Rail Material: Galvanized wrought steel or Extruded aluminum.
2. Door Type: Single or Biparting.
3. Rail Configuration: V-grooved double leg or I-beam.
4. Wheel Assembly: Two wheel or four wheel, with roller bearings.
5. Pulls: Flush, mortised into door, Cast, forged, or extruded brass or bronze surface-applied type, wrought brass or bronze edge type, mortised into edge of door, Sliding door latch or Sliding door lock with emergency release.
6. Accessories:

a. Bumper stops; wrought steel.
b. Floor guides installed within pocket.

2.32 FOLDING DOOR HARDWARE

A. General: BHMA A156.14; complete sets including overhead rails, hangers, supports, bumpers, floor guides, and accessories indicated.

B. Bifolding Door Hardware: Rated for door panels weighing up to 50 lb (23 kg) Grade 1 or 30 lb (14 kg) Grade 2; with rails and door hardware that allow horizontal and vertical adjustment.

1. Rail Material: Galvanized wrought steel or Extruded aluminum.
2. Rail Configuration: V-grooved double leg, V-grooved double leg with fascia or I-beam.
3. Mounting: Surface mounted overhead or Top and bottom hung.
4. Wheel Assembly: Two wheel or four wheel, with roller bearings.

C. Multiple Folding Door Hardware: Rated for door panels weighing up to 50 lb (23 kg) Grade 1 or 30 lb (14 kg) Grade 2; with rails and door hardware that allows horizontal and vertical adjustment.

1. Rail Material: Galvanized wrought steel or Extruded aluminum.
2. Rail Configuration: V-grooved double leg, V-grooved double leg with fascia or I-beam.
3. Mounting: Surface mounted overhead or Top and bottom hung.
4. Wheel Assembly: Two wheel or four wheel, with roller bearing.

2.33 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch (1.3-mm) thick aluminum, brass. Bronze or stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

B. Armor Plates: 36 inches (914 mm), 40 inches (1016 mm) or 42 inches (1067 mm) high by door width with allowance for frame stops.

C. Kick Plates: 8 inches (203 mm), 10 inches (254 mm) or 12 inches (305 mm) high by door width with allowance for frame stops.

D. Mop Plates: 4 inches (102 mm) or 6 inches (152 mm) high by 1 inch (25 mm) less than door width.

2.34 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

B. Chain Door Guards: Grade 1, Grade 2 or Grade 3; polished cast brass or bronze or extruded brass; with plate slotted to receive 6-inch (150-mm) long welded chain secured to an anchor plate. Guard allows door to be opened 3 inches (75 mm) with chain engaged in slotted plate. Equip with chain holder.

C. Rod-Type Door Guards: Grade 1, Grade 2 or Grade 3; straight door-mounted rod that engages U-shaped, jamb-mounted rod. U-shaped rod can swing 180 degrees away from door; rod limits door opening when engaged.

1. Material: Brass, Bronze or Aluminum.

D. Coat Hooks: Grade 1, Grade 2 or Grade 3; two curved hooks with rounded ends; 3-inch (75-mm) projection from wall; for surface-screw application.

1. Material: Polished cast brass, Polished cast bronze or Burnished cast aluminum.

E. Garment Hooks: Grade 1, Grade 2 or Grade 3; one long hat hook and one small coat hook; 3-3/4-inch (95-mm) projection from wall with 7-inch (178-mm) overall height; for surface-screw application.

1. Material: Polished cast brass or Burnished cast aluminum.

F. Door Knockers: Grade 1; solid brass with engraved number and nameplates.

G. Wide-Angle Door Viewers: Grade 1, Grade 2 or Grade 3; solid brass with optical glass lenses; adjustable to door thickness and permitting one-way observation with minimum 190-degree viewing angle.

H. Fire-Rated Door Viewers: Solid brass with optical glass lenses; listed and labeled for use in fire-rated assemblies; adjustable to door thickness and permitting one-way observation with minimum 120, 150 or 190-degree viewing angle.

I. House Numbers: Grade 1; wrought, cast, or forged brass; 4 inches (102 mm) high; for screw application.

J. Silencers for Wood Door Frames: Grade 1; neoprene or rubber; minimum 5/8 by 3/4 inch (16 by 19 mm); fabricated for drilled-in application to frame.

K. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.35 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

B. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; listed and labeled for use with fire-alarm systems.

C. Door Position Switches: Magnetically operated reed switch designed for concealed mounting.

D. Door and Frame Transfer Devices: Steel housing for mortise in hinge stile of door, with flexible tube for wiring bundle; accommodating doors that swing open to 120 degrees.

2.36 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated on Drawings or to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule or as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening or least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.

Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

END OF SECTION 087111

SECTION 087113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-energy door operators for swinging doors.
2. Power-assist door operators for swinging doors.

1.2 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Double-Egress (Doors): A pair of doors that simultaneously swing, with the two doors moving in opposite directions with no mullion between them.

C. Double-Swing (Doors): A pair of doors that swing, with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For automatic door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Field quality-control reports.

C. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

B. Certified Inspector Qualifications: Certified by AAADM.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: As directed.

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of, as directed.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

C. Electrohydraulic Operating System: Self-contained, low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch (3.2-mm) thick, extruded or formed aluminum and extending full width of door opening, including door jambs, to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch (3.2-mm) thick, extruded or formed aluminum; manufacturer's standard width; continuous over full width of operator-controlled door opening; continuous over full width of door opening, including door jambs; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

F. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

G. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.19.

B. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf (67 N) required to release latch if provided, not more than 30 lbf (133 N) required to manually set door in motion, and not more than 15 lbf (67 N) required to fully open door.
2. Entrapment-Prevention Force: Not more than 15 lbf (67 N) required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One or Two way.
2. Operator Mounting: Surface or Overhead concealed.

D. Configuration: Operator to control pair of swinging doors.

1. Traffic Pattern: One way, Two way, Double egress or Double swing.
2. Operator Mounting: Surface or Overhead concealed.

E. Operation: Power opening and power-assisted spring closing. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

F. Operating System: Electromechanical or Electrohydraulic.

G. Microprocessor Control Unit: Solid-state controller.

H. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator; key operated.

I. Activation Device: Push-plate switch, Touchless switch or Push-button switch on each side of door to activate door operator.

J. Exposed Finish: Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, Baked-enamel or powder-coat finish, finish matching door and frame or Finish matching door hardware.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.4 POWER-ASSIST DOOR OPERATORS FOR SWINGING DOORS

A. Standard: BHMA A156.19.

B. Performance Requirements:

1. Opening Force:

a. Opening Force if Power Fails: Not more than 15 lbf (67 N) required to release latch if provided, not more than 30 lbf (133 N) required to manually set door in motion, and not more than 15 lbf (67 N) required to fully open door.
b. Accessible Interior Doors: Not more than 5 lbf (22 N) to push or pull door to fully open position.

2. Entrapment-Prevention Force: Not more than 15 lbf (67 N) required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One or Two way.
2. Operator Mounting: Surface or Overhead concealed.

D. Configuration: Operator to control pair of swinging doors.

1. Traffic Pattern: One way, Two way, Double egress or Double swing.
2. Operator Mounting: Surface or Overhead concealed.

E. Operation: Power-assisted opening that reduces the force to open door and power-assisted spring closing. Pushing or pulling on door activates operator. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

F. Operating System: Electromechanical or Electrohydraulic.

G. Microprocessor Control Unit: Solid-state controller.

H. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator: key operated.

I. Exposed Finish: Class I, clear anodic finish, Class II, clear anodic finish, Class I, color anodic finish, Class II, color anodic finish, Baked-enamel or powder-coat finish, finish matching door and frame or Finish matching door hardware.

1. Color: Light bronze, Medium bronze, Dark bronze, Black, as indicated by manufacturer's designations, match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B221 (ASTM B221M).
2. Sheet: ASTM B209 (ASTM B209M).

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 CONTROLS

A. General: Provide controls in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate devices with door operation and door operator mechanisms.

B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Round or Square push plate with 4-by-4-inch (100-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semiflush in wall or Surface mounted on wall.

2. Configuration: Rectangular push plate with 2-by-4-inch (50-by-100-mm) junction box.

    a. Mounting: As indicated on Drawings, Recess mounted, semiflush in wall, Recess mounted in door jamb, Surface mounted on wall or Surface mounted on post.

3. Push-Plate Material: Stainless steel or Plastic as selected by Architect from manufacturer's full range.
4. Message: Plain face with no message, "Push to Open", International symbol of accessibility or International symbol of accessibility and "Push to Open."

C. Touchless Switch: Hands-free activation door-control switch with flat motion sensor face-plate with contrasting-colored, engraved message.

1. Configuration: 6-inch (152.4-mm) round, 4.56-by-4.56-inch (115.8-by-115.8-mm) (double gang) square, 2.77-by-4.56-inch (70-by-115.8-mm) (single gang) rectangular or 1.68-by-4.56-inch (42.6-by-115.8-mm) jamb-style face plate.

    a. Mounting: As indicated on Drawings, Recess mounted in wall, Recess mounted in door jamb or Surface mounted on wall.

2. Face-Plate Material: Stainless steel, Plastic, Stainless steel with backlight acrylic window or as selected by Architect from manufacturer's full range of options.
3. Message: "Wave to Open", "Wave to Open" and wave symbol, International symbol of accessibility or International symbol of accessibility and "Wave to Open" and wave symbol.

D. Push-Button Switch: Momentary-contact door control switch with one red-button actuator; enclosed in nominal 2-by-4-inch (50-by-100-mm) or 4-by-4-inch (100-by-100-mm) junction box.

1. Provide faceplate engraved with "Press to Open" text and international symbol of accessibility in contrasting color.
2. Provide blue plastic cover engraved with "Press Button to Open" in white text and with international symbol of accessibility.
3. Mounting: As indicated on Drawings, Surface mounted on wall, Surface mounted on post, Surface mounted on guide rail or Recess mounted in wall.
4. Faceplate Material: Stainless steel or Painted metal as selected by Architect from manufacturer's full range.

E. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.

1. Application Process: Decals, Silk-screened or Operator manufacturer's standard process.
2. Provide sign materials with instructions for field application when operators are installed.

2.8 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.

B. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.

C. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install automatic door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

B. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch (6 mm) and less than 3/4 inch (19 mm) with door in any position.

C. Controls: Install devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel.

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

E. Adjusting: Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for tight closure.
2. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

F. Demonstration: Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

3.2 FIELD QUALITY CONTROL

A. Certified Inspector: Owner will engage or engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic door operators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 087113

SECTION 087163 - DETENTION DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes detention door hardware.

B. Related Requirements:

1. Section 013513.16 "Special Project Procedures for Detention Facilities" for general requirements for detention work.

1.2 COORDINATION

A. Templates: Obtain and distribute, to the parties involved, templates for detention doors, frames, and other work specified to be factory prepared for installing detention door hardware.

1.3 PREINSTALLATION MEETINGS

A. Detention Keying Conference: Conduct conference at Project site.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of detention door hardware. Include plans, elevations, sections, and attachment details.

1. Wiring Diagrams: For power, signal, and control wiring; differentiate between manufacturer-installed and field-installed wiring for detention door hardware.

C. Detention Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware as well as installation procedures and wiring diagrams. Coordinate the Detention Door Hardware Schedule with detention doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of detention door hardware.

1. Integrate detention door hardware indicated in "Detention Door Hardware Schedule" Article into Project's final Detention Door Hardware Schedule, and indicate complete designations of every item required for each detention door and opening.
2. Keying Schedule: Coordinate detention keying with other door hardware in Project's final Keying Schedule.

3. Indicate each detention lock and type of key cylinder using the following prefixes: "P" for paracentric, "M" for mogul, "HS" for high security, and "C" for commercial.
4. Indicate security level of each item.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

1. Field quality-control certification signed by Contractor and Detention Specialist.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of detention door hardware.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Detention Door Hardware: As directed.
2. Electrical Parts: As directed.
3. Security Fasteners: Furnish not less than one box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.
4. Tools: Provide two sets of tools for installing and removing security fasteners.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and an authorized representative of detention door hardware manufacturer for installation and maintenance of units required for this Project.

B. Supplier Qualifications: Detention door hardware supplier with warehousing facilities in Project's vicinity who is, or employs, a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about detention door hardware and keying.

1. Detention Door Hardware Supplier Qualifications: An experienced detention door hardware supplier who has completed projects with electrically powered detention door hardware similar in material, design, and extent to that indicated for this Project, whose

work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

a. Engineering Responsibility: Prepare data for electrically powered detention door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
b. Scheduling Responsibility: Preparation of Detention Door Hardware and Keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for detention door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver detention door keys to Owner by registered mail or overnight package service, addressed as follows:

1. As directed by Owner.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of detention door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and detention door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering or detention use.

2. Warranty Period: Three years from date of Substantial Completion.
3. Warranty Period for Security Door Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Swinging Detention Door Assemblies: Provide detention door hardware as part of a detention door assembly that complies with security grade indicated, when tested according to ASTM F1450, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

1. Bullet Resistance: Comply with Level 3 rating when tested according to UL 752; where indicated on Drawings, in door schedule or as directed.

    a. Listed and labeled as bullet resistant by a testing agency acceptable to authorities having jurisdiction.

2. Tool-Attack Resistance: Comply with small-tool-attack-resistance rating when tested according to UL 1034 and UL 437; where indicated on Drawings, in door schedule or as directed.

2.2 DETENTION DOOR HARDWARE, GENERAL

A. Regulatory Requirements:

1. Fire-Rated Detention Door Assemblies: Provide detention door hardware for assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
2. Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC A117.1 and as directed.

2.3 DETENTION HINGES

A. Standard for Electric Detention Hinges: UL 634.

B. Utility-Door Detention Hinges: Heavy weight, plain bearing; fabricated from cast iron or steel; 3/8-inch (9.5-mm) diameter, case-hardened, fully welded, steel hinge pin; full surface.

1. Leaves: Drilled for countersunk security fasteners or Solid.
2. Size: Minimum 3 by 4 by 0.200 inch (75 by 102 by 5 mm).
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1758.
4. Finish: BHMA 600.

C. Food-Pass Detention Hinges: Heavy weight, plain bearing; fabricated from cast iron or steel; 3/8-inch (9.5-mm) diameter, case-hardened, fully welded, steel hinge pin; with applied stop preventing door from opening more than 90 degrees and supporting door in horizontal position as a shelf; full surface.

1. Leaves: Drilled for countersunk security fasteners or Solid.
2. Size: Minimum 3 by 4 by 0.200 inch (75 by 102 by 5 mm).
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1758.
4. Finish: BHMA 600.

D. Full-Surface Detention Hinges: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; 3/4-inch (19-mm) diameter, case-hardened, fully welded, steel hinge pin.

1. Leaves: Drilled for countersunk security fasteners or Solid.

2. Size: Minimum 5 by 5-1/4 by 1/2 inch (127 by 133 by 13 mm).
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1758.
4. Finish: BHMA 600.

E. Half-Surface Detention Hinges: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; 3/4-inch (19-mm) diameter, case-hardened, fully welded, steel hinge pin.

1. Leaves: Drilled for countersunk security fasteners or Solid.
2. Size: Minimum 5 by 5-1/4 by 1/2 inch (127 by 133 by 13 mm).
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1758.
4. Finish: BHMA 600.

F. Gap-Mounted Detention Hinges: Extra heavy weight; two heavy-duty thrust bearings with hardened-steel ball bearings; fabricated from steel plate; 3/4-inch (19-mm) diameter, case-hardened, fully welded, steel hinge pin.

1. Leaves: Drilled for countersunk security fasteners or Solid.
2. Size: Minimum 5 by 6 by 1/2 inch (127 by 152 by 13 mm).
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1758.
4. Finish: BHMA 600.

2.4 MECHANICAL DETENTION LOCKS AND LATCHES

A. Lock Mountings:

1. Hollow-Metal Detention Doors: Mount detention lock to back of 0.179-inch (4.56-mm) nominal-thickness steel or 0.183-inch (4.65-mm) nominal-thickness, galvanized-steel cover plate for installation in lock pocket fabricated into detention door. Attach cover plate to hollow-metal detention door with security fasteners.
2. Bar-Grille Detention Doors: Mount detention lock to back of galvanized-steel enclosure welded to flat horizontal bars of bar-grille detention door; cover with 0.179-inch (4.56-mm) nominal-thickness steel or 0.183-inch (4.65-mm) nominal-thickness, galvanized-steel plate. Attach plate with security fasteners.
3. Steel-Plate Detention Doors: Mount detention lock to inside surface of 0.179-inch (4.56-mm) nominal-thickness steel, 0.134-inch (3.42-mm) nominal-thickness steel, 0.183-inch (4.65-mm) nominal-thickness, galvanized-steel or 0.138-inch (3.50-mm) nominal-thickness, galvanized-steel enclosure with integrally formed mounting flanges. Attach enclosure to steel-plate detention door with security fasteners or rivets.

B. Utility-Door Mechanical Deadlocks, Paracentric Cylinder:

1. Function: Lockbolt retracted and extended by five or six-tumbler paracentric cylinder; keyed one side or two sides.
2. Lockbolt: 1-1/2 inches high by 3/4 inch (38 mm high by 19 mm) thick; 5/8-inch (16-mm) throw.
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

C. Utility-Door Mechanical Deadlocks, Mogul Cylinder:

1. Function: Lockbolt retracted and extended by mogul cylinder; keyed one side or two sides.
2. Lockbolt: 1-1/2 inches high by 3/4 inch (38 mm high by 19 mm) thick; 5/8-inch (16-mm) throw.
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

D. Utility-Door Mechanical Snaplatches, Paracentric Cylinder:

1. Function: Automatic snaplatch when door is closed; latchbolt retracted by five or six-tumbler paracentric cylinder; keyed one side or two sides.
2. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

E. Utility-Door Mechanical Snaplatches, Mogul Cylinder:

1. Function: Automatic snaplatch when door is closed; latchbolt retracted by mogul cylinder; keyed one side or two sides.
2. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 5/16-inch (8-mm) throw.
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

F. Mechanical Concealed Snaplatches, Paracentric Cylinder:

1. Function: Automatic snaplatch when door is closed; latchbolt retracted by five-tumbler paracentric cylinder; keyed one side. When closed, latch is concealed within lock case.
2. Latchbolt: 1 inch high by 7/16 inch (25 mm high by 11 mm) thick; 7/16-inch (11-mm) throw.
3. Provide angled strike.
4. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

G. Mechanical Snaplatches, Paracentric Cylinder:

1. Function: Automatic snaplatch when door is closed (slam locking); latchbolt retracted by half turn and extended by full turn in opposite direction of five or six-tumbler paracentric cylinder; keyed one side or two sides.

    a. Knob operation retracts latchbolt unless deadlocked. Locate knobs on one side or two sides.

2. Latchbolt: 2-inch-high by 3/4-inch (51-mm-high by 19-mm) thick steel, with two case-hardened-steel insert pins; 3/4-inch (19-mm) throw; 1/2-inch (13-mm) or 1-1/4-inch (32-mm) bolt projection when retracted.
3. Listed and labeled for use on fire doors.
4. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

H. Mechanical Deadlatches/Deadlocks, Paracentric Cylinder:

1. Function: Automatic snaplatch and automatic deadlock through action of actuator when door is closed (slam locking); latchbolt retracted by five or six-tumbler paracentric cylinder; keyed one side or two sides.

2. Latchbolt: 2-inch-high by 3/4-inch (51-mm-high by 19-mm) thick steel, with two case-hardened-steel insert pins; 3/4-inch (19-mm) throw; 1/2-inch (13-mm) or 1-1/4-inch (32-mm) bolt projection when retracted.
3. Deadlock Actuator: 3/4-inch-high by 3/4-inch (19-mm-high by 19-mm-) thick steel; 1/2-inch (13-mm) throw.
4. Listed and labeled for use on fire doors.
5. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

I. Mechanical Deadlocks, Paracentric Cylinder:

1. Function: Deadlocked in both locked and unlocked position; latchbolt retracted and extended by five or six-tumbler paracentric cylinder; keyed one side or two sides.
2. Latchbolt: 2-inch-high by 3/4-inch (51-mm-high by 19-mm) thick steel, with two case-hardened-steel insert pins; 3/4-inch (19-mm) throw; 1/2-inch (13-mm) or 1-1/4-inch (32-mm) bolt projection when retracted.
3. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

2.5 ELECTROMECHANICAL DETENTION LOCKS AND LATCHES

A. Connectors: Provide electromechanical detention locks and latches with factory-wired plug connector with 6-inch (152-mm) wire pigtail.

1. Provide security ring for installation of electromechanical detention lock in hollow-metal detention frame, welded to frame or access cover.
2. Equip direct-current, solenoid-operated detention locks and latches with diode transient voltage protection at each locking device.

B. Solenoid-Operated Deadlatches, Paracentric Cylinder:

1. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by five or six-tumbler paracentric cylinder; keyed one side or two sides; if latchbolt is retracted by key, it remains retracted until relocked by key.

    a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is activated; latchbolt extends when power is discontinued.
    b. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 2-inch-high by 3/4-inch (51-mm-high by 19-mm) thick hardened steel; 3/4-inch (19-mm) throw.
3. Provide internal deadlock indicator switch.
4. Provide roller-type deadlock actuator.
5. Voltage: 120-V ac.
6. Listed and labeled for use on fire doors.
7. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

C. Motor-Operated Deadlatches, Paracentric Cylinder:

1. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by five or six-tumbler paracentric cylinder; keyed one side or two sides; if latchbolt is retracted by key, it remains retracted until relocked by key.

    a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is activated; latchbolt extends when power is discontinued.
    b. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 2-inch-high by 3/4-inch (51-mm-high by 19-mm) thick hardened steel; 3/4-inch (19-mm) throw.
3. Provide internal deadlock indicator switch.
4. Provide roller-type deadlock actuator.
5. Voltage: 120-V ac or 24-V dc.
6. Listed and labeled for use on fire doors.
7. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

D. Solenoid-Operated Deadlatches, Mogul Cylinder:

1. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by mogul cylinder; keyed one side or two sides.

    a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is activated; latchbolt extends when power is discontinued.
    b. Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically.
    c. Key Holdback: If latchbolt is retracted by key, it remains retracted until relocked by key.
    d. Knob operation retracts latchbolt; always active.
    e. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 1-1/2-inch-high by 3/4-inch (38-mm-high by 19-mm) thick hardened steel; 1-inch (25-mm) throw.
3. Provide internal deadlock indicator switch.
4. Provide roller-type deadlock actuator.
5. Voltage: 120-V ac.
6. Listed and labeled for use on fire doors.
7. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

E. Motor-Operated Deadlatches, Mogul Cylinder:

1. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by mogul cylinder; keyed one side or two sides.

a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is in open position; latchbolt extends when control switch is moved to locked position.
b. Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically.
c. Key Holdback: If latchbolt is retracted by key, it remains retracted until relocked by key.
d. Knob operation retracts latchbolt; always active.
e. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 1-1/2-inch-high by 3/4-inch (38-mm-high by 19-mm) thick hardened steel; 1-inch (25-mm) throw.
3. Provide internal deadlock indicator switch.
4. Provide roller-type deadlock actuator.
5. Voltage: 120-V ac or 24-V dc.
6. Listed and labeled for use on fire doors.
7. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

F. Solenoid-Operated Deadlatches, Commercial Cylinder:

1. Function: Remote switch activates electric solenoid that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by high-security commercial cylinder; keyed one side or two sides.

a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is activated; latchbolt extends when power is discontinued.
b. Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically.
c. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 1-1/2-inch-high by 5/8-inch (38-mm-high by 16-mm) thick hardened steel; 3/4-inch (19-mm) throw.
3. Provide internal deadlock indicator switch.
4. Deadlock Actuator: Stainless steel.
5. Strike: Stainless steel.
6. Voltage: 24-V dc.
7. Listed and labeled for use on fire doors.
8. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

G. Motor-Operated Deadlatches, Commercial Cylinder:

1. Function: Remote switch activates electric motor that retracts latchbolt; automatic latching and deadlocking when door is closed (slam locking). Latchbolt can be mechanically retracted by high-security commercial cylinder; keyed one side or two sides.

a. Latchback: Latchbolt remains retracted until door is opened 2 inches (51 mm), then releases or as long as control switch is in open position; latchbolt extends when control switch is moved to locked position.

b. Local Electric Key (LEK): Inmate key operates lock electrically when enabled; staff key always operates lock manually and electrically.
c. If power fails, latchbolt automatically deadlocks (fail secure).

2. Latchbolt: 1-1/2-inch-high by 5/8-inch (38-mm-high by 16-mm) thick hardened steel; 3/4-inch (19-mm) throw.
3. Provide internal deadlock indicator switch.
4. Deadlock Actuator: Stainless steel.
5. Strike: Stainless steel.
6. Voltage: 24-V dc.
7. Listed and labeled for use on fire doors.
8. Security Grade: 1, 2, 3 or 4 according to ASTM F1577.

2.6 DETENTION LOCK TRIM

A. Levers: Solid stainless steel.

B. Knobs: Stainless steel or Brass.

C. Escutcheons for Paracentric Locks: 0.125-inch (3.18-mm-) thick, 3-inch- (75-mm) diameter stainless steel with BHMA 630 or brass with BHMA 606 finish. Attach with security fasteners.

1. Style: Single wing, Double wing, Single or double wing as required by lock function or as indicated.

D. Cylinder Shields for Paracentric Locks: 0.125-inch (3.18-mm) thick, 3-inch (75-mm) diameter stainless steel with BHMA 630 or brass with BHMA 606 finish and swinging cover to protect keyhole. Attach with security fasteners.

1. Style: Single wing, Double wing, Single or double wing as required by lock function or as indicated.

2.7 DETENTION CYLINDERS AND KEYING

A. Source Limitations: Subject to compliance with requirements, provide cylinders and keying for paracentric and mogul cylinders by same manufacturer as for detention locks and latches.

B. Paracentric Cylinders: Manufacturer's standard lever-tumbler type, constructed from one-piece spring-tempered brass; with tumblers activated by phosphor bronze springs; five tumblers per lock.

C. Mogul Cylinders: Manufacturer's standard pin-tumbler type, minimum 2-inch (51-mm) diameter; body constructed from brass or bronze, stainless steel, or nickel silver; with stainless-steel tumblers and engaging cylinder balls; complying with the following:

1. Number of Pins: Five, Six, Seven or as directed.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.

a. High-Security Grade: Listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).

3. Finish: BHMA 606, BHMA 626, BHMA 630 or as directed.

D. Keying System: Provide a factory-registered keying system complying with the following requirements:

1. Paracentric cylinders operated by change keys only.
2. No Master Key System: Mogul cylinders operated by change keys only.
3. Master Key System: Mogul cylinders operated by a change key and a master key.
4. Grand Master Key System: Mogul cylinders operated by a change key, a master key, and a grand master key.
5. Great-Grand Master Key System: Mogul cylinders operated by a change key, a master key, a grand master key, and a great-grand master key.
6. Existing System: Master key or grand master key mogul-cylinder locks to Owner's existing system.
7. Existing System: Re-key Owner's existing master key system for mogul-cylinder locks into new keying system.

E. Keys: Provide cast silicon-bronze copper alloy keys complying with the following:

1. Stamping: Permanently inscribe each key with a visual key-control number and include the following notation:

a. "DO NOT DUPLICATE" or Information to be furnished by Owner.

2. Quantity: In addition to one extra blank key for each lock, provide the following:

a. Cylinder Change Keys: Three or as directed.
b. Master Key(s): One or as directed.
c. Grand Master Key(s): One or as directed.
d. Great-Grand Master Key(s): One or as directed.

2.8 SWITCHES

A. General: Provide switches configured with contact type required for functions indicated, including multiple circuiting where required by functional performance of Section 285211 "Detention Monitoring and Control Systems."

B. Concealed, Magnetic Door Position Switches: Consist of actuating magnet mortised into detention door and switch mortised into frame; with stainless-steel faceplates; 24-V dc, factory wired with plug connector. Wire in series with lock monitors. Attach with security fasteners.

C. Concealed, Mechanical Door Position Switches: Consist of metal track mortised into head of detention door connected by steel actuator arm to steel actuator mortised into frame; switch fully concealed when door is in closed position; with stainless-steel faceplate; 120-V ac; factory wired with plug connector. Action of door mechanically activates switch. Wire in series with lock monitors. Attach with security fasteners.

D. Surface-Mounted Door Position Switches: Switch enclosed in 0.134-inch (3.42-mm) nominal-thickness steel enclosure, factory primed for painting; 120-V ac; factory wired with plug connector. Wire in series with lock monitors. Attach with security fasteners.

1. Galvanize enclosure for exterior locations and where indicated.

E. Strike Indicator Switches: Designed to be mortised behind strike and to indicate whether door is locked or unlocked; enclosed in metal strike box. Wire in series with door position switches. Attach with security fasteners.

1. Voltage: 120-V dc, 240-V ac or as indicated.
2. Locations: At doors with mechanical detention lock or Where indicated.
3. Manufacturer: Same as detention lock.

F. Inmate Door-Control Switches: Momentary or Maintained-contact push-button switch with metal faceplate. Attach with security fasteners.
1.
2. Material and Finish: Brass with BHMA 606, Brass with BHMA 626 or Stainless steel with BHMA 630 finish.
3. Operation: When activated from remote location, switch allows inmate operation of electric cell door lock.

G. Push-Button, Inmate Door-Control Switches: Momentary or Maintained-contact push-button switch for installation without faceplate. Attach with security fasteners.

1. Material and Finish: Brass with BHMA 606, Brass with BHMA 626 or Stainless steel with BHMA 630 finish.
2. Operation: When activated from remote location, switch allows inmate operation of electric cell door lock.

2.9 DETENTION OPERATING TRIM

A. Standard: BHMA A156.6, Grade 1.

B. Surface-Mounted Door Pulls: 8-3/4-inch (222-mm) overall length and 2-1/4-inch (57-mm) projection; attach to door with two security fasteners.

1. Material: Cast bronze with BHMA 606 or BHMA 626 finish.
2. Material: Cast stainless steel with BHMA 630 finish.

C. Round, Surface-Mounted Door Pulls: 7-inch (178-mm) overall length by 1-inch (25-mm) diameter solid bar, with 2-1/4-inch (57-mm) projection; attach to door with two security through bolts.

1. Material: Cast or extruded bronze with BHMA 606 or BHMA 626 finish.
2. Material: Cast stainless steel with BHMA 630 finish.

D. Flush Door Pulls: 5 inches high by 4 inches wide by 1 inch deep (127 mm high by 102 mm wide by 25 mm deep), with 1/8-inch (3-mm) thick faceplate; attach to door with four security fasteners.

1. Material: Formed, wrought, or cast brass/bronze with BHMA 606 or BHMA 626 finish.
2. Material: Formed or cast stainless steel with BHMA 630 finish.

E. Knob Pulls: 2-inch (51-mm) diameter; fabricated from solid brass with BHMA 606 or BHMA 626 finish. Attach with security fasteners.

2.10 SECURITY DOOR CLOSERS

A. Standard: BHMA A156.4, Grade 1.

1. Certified Products: Provide security door closers listed in BHMA's "Directory of Certified Door Products."

B. Surface-Mounted Security Door Closers:

1. Arms: Minimum 3/8-inch (9.5-mm) thick by 1-1/8-inch (29-mm) wide, rectangular steel main arm; 5/16-inch (8-mm) thick by 1-inch (25-mm) wide, rectangular steel secondary arm; full rack-and-pinion type; fabricated with orbital-riveted, pinned, or welded elbow and arm shoe/soffit plate joints designed to prevent disassembly with ordinary hand tools.
2. Cover: Heavy-duty metal, attached with four security fasteners.
3. Mounting: Attach security door closer with security fasteners.

C. Concealed Security Door Closers:

1. Construction: Forged-steel arm; security roller; with track concealed in head of detention door, designed to eject foreign objects during opening and closing; fabricated with joints designed to prevent disassembly with ordinary hand tools. Closer arm and track fully concealed when door is closed.
2. Cover Plates: Heavy-duty metal, attached with security fasteners.
3. Provide door position switch integral to closer.

D. Unit Size: Comply with manufacturer's written recommendations for size of security door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to comply with field conditions and requirements for opening force.

2.11 DETENTION DOOR STOPS

A. Detention Floor Stops: 1-1/2-inch-high by 2-inch (38-mm-high by 51-mm) diameter, rubber bumper mounted on steel lag bolt; BHMA A156.16; install in floor with nonshrink grout; for detention doors unless wall or other type stops are indicated. Do not mount floor stops where they can impede traffic.

B. Silencers for Detention Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum 1/2-inch (13-mm) diameter; fabricated for drilled-in application to detention door frame. Attach with security fasteners.

2.12 KEY-CONTROL SYSTEM

A. Security Key Cabinets: Metal cabinet for mounting 150 or 300 paracentric or mogul keys.

1. Cabinet: Minimum 16 inches (406 mm) wide by 24 inches (610 mm) high by 6-1/2 inches (165 mm) deep; formed from 0.134-inch (3.42-mm) nominal-thickness steel sheet. Provide 0.060-inch (1.52-mm) nominal-thickness, steel-sheet interior panels, supported on pivots.
2. Doors: Formed from same material as cabinet, supported by heavy-duty, continuous, side hinge welded to cabinet and door; with tumbler deadlock.
3. Cross-Index System: Set up by detention key-control manufacturer; include labels, two sets of key tags with self-locking key holders, key-gathering envelopes, temporary and permanent markers, and the following:

    a. Card Index: Furnish four sets of index cards for recording key information. Include three receipt forms for each key-holding hook.
    b. Computer Software: Furnish cross-index software for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.

B. Finishes: Prime or Factory finish.

1. Color and Gloss: As directed.

2.13 FABRICATION

A. Base Metals: Produce detention door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified detention door hardware units and BHMA A156.18 finishes.

B. Fasteners: Provide flat-head security fasteners with finished heads to match surface of detention door hardware.

1. Security Fasteners: Fabricate detention door hardware using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials.
2. Concealed Fasteners: For detention door hardware units that are exposed when detention door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching detention door hardware. Where using through bolts on hollow-metal detention door and frame construction, provide sleeves for each through bolt.

2.14 HARDWARE FINISHES

A. Standard: Comply with BHMA A156.18.

2.15 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific fastener type.

1. Drive-System Type: Pinned Torx-Plus or Pinned Torx.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine detention doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention door hardware connections before detention door hardware installation.

C. Inspect built-in and cast-in anchor installations, before installing detention door hardware, to verify that anchor installations comply with requirements. Prepare inspection reports.

D. Examine roughing-in for electrical power systems to verify actual locations of connections before detention door hardware installation.

3.2 PREPARATION

A. Steel Detention Doors and Frames: Comply with BHMA A156.115 Series.

1. Surface-Applied Detention Door Hardware: Drill and tap detention doors and frames according to SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."

B. Where cutting and fitting are required to install detention door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Install interconnecting wiring and connectors between detention door hardware devices. Terminate device wiring for detention door hardware installed in swinging doors at a plug-type connector located in lock pocket or door frame junction box.

D. Security Fasteners: Install detention door hardware using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials.

3.4 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Perform the following tests and inspections:

1. After installing electrically powered detention door hardware and after electrical circuitry has been energized, test detention door hardware for compliance with requirements.

    a. Test: Operate lock of each door and group of doors in normal remote, normal local, and emergency operating modes. Verify that remote controls operate correct door locks and in correct sequence.

2. Verify that lock bolts engage strikes with required bolt projection.

C. Prepare field quality-control certification endorsed by Detention Specialist that states installed products comply with requirements in the Contract Documents.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train or Train Owner's maintenance personnel to adjust, operate, and maintain detention door hardware and detention door hardware finishes.

3.6 DETENTION DOOR HARDWARE SCHEDULE

A. General: Provide detention door hardware for each detention door to comply with requirements in this Section and with detention door hardware sets.

END OF SECTION 087163

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls, sloped glazing or skylights.
2. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Windborne-Debris Impact Resistance: As directed Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: As directed Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate

manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Ultraclear Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent and solar heat gain coefficient of not less than 0.87.

C. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

D. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

E. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

F. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

G. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."

H. Reflective-Coated Vision Glass: ASTM C1376.

I. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

J. Silicone-Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.

K. Reflective-Coated Spandrel Glass: ASTM C1376, Kind CS.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.
2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
3. Ionomeric polymer interlayer.
4. Cast-in-place and cured-transparent-resin interlayer.
5. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seals.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction, Aluminum with mill or clear anodic finish, Aluminum with black, color anodic finish, Aluminum with bronze, color anodic finish, Aluminum with powdered metal paint finish in color selected by Architect, Galvanized steel, Stainless steel, Polypropylene-covered stainless steel in color selected by Architect, Thermally broken aluminum, Nonmetallic laminate, Nonmetallic tube or Silicone with integral desiccant and vapor barrier.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Applications: As directed.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Applications: As directed.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Applications: As directed.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Applications: As directed.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:

1. As directed EPDM, Silicone, Neoprene or Santoprene with a Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended by sealant or glass manufacturer.

C. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended by sealant or glass manufacturer.

D. Edge Blocks:

1. As directed EPDM, Silicone, Neoprene or Santoprene with a Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended by sealant or glass manufacturer.

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-#: As directed Clear annealed, heat-strengthened or fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

B. Glass Type GL-#: As directed Ultraclear annealed, heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed AGC Glass Company North America, Inc.; Krystal Klear, Guardian Industries Corp.; Ultrawhite, Pilkington North America Inc.; Optiwhite, PPG Industries, Inc.; Starphire or Saint-Gobain Corporation; Diamant.
2. Minimum Thickness: 6 mm.
3. Safety glazing required.

C. Glass Type GL-#: As directed Pyrolytic-coated, self-cleaning, low-maintenance, clear annealed, heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed Cardinal Glass Industries; Neat, Pilkington North America Inc.; Activ, Saint-Gobain Corporation; Bioclean.
2. Minimum Thickness: 6 mm.
3. Safety glazing required.

D. Glass Type GL-#: As directed Tinted annealed, heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product:.
2. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
3. Minimum Thickness: 6 mm.
4. Visible Light Transmittance: Percent minimum As directed.
5. Solar Heat Gain Coefficient: Maximum As directed.
6. Safety glazing required.

E. Glass Type GL-#: Ceramic-coated vision glass; heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Glass: As directed Clear, Ultraclear or Tinted float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Ceramic Coating Color and Pattern: As selected by Architect from manufacturer's full range or Match Architect's samples.
5. Minimum Thickness: 6 mm.
6. Coating Location: Second surface.
7. Visible Light Transmittance: Percent minimum As directed.
8. Solar Heat Gain Coefficient: Maximum As directed.
9. Safety glazing required.

F. Glass Type GL-#: As directed Reflective-coated vision glass; annealed, heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed
2. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).
3. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
4. Coating Color: As directed Gold, Pewter or Silver.
5. Glass: As directed Clear or Tinted float glass.
6. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
7. Minimum Thickness: 6 mm.
8. Coating Location: As directed First or Second surface.
9. Outdoor Visible Reflectance: Percent maximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

G. Glass Type GL-#: As directed Ceramic-coated spandrel glass; heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Glass: As directed Clear, Ultraclear or Tinted float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Coating Color: As selected by Architect from manufacturer's full range or Match Architect's samples.
5. Minimum Thickness: 6 mm.
6. Coating Location: Second surface.

H. Glass Type GL-#: As directed Silicone-coated spandrel glass; heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Glass: As directed Clear, Ultraclear or Tinted float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Coating Color: As selected by Architect from manufacturer's full range or Match Architect's samples.

5. Minimum Thickness: 6 mm.
6. Coating Location: Second surface.

I. Glass Type GL-#: Reflective-coated spandrel glass; heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
3. Coating Color: As directed Gold, Pewter or Silver.
4. Glass: As directed Clear, Ultraclear or Tinted float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Minimum Thickness: 6 mm.
7. Coating Location: As directed First or Second surface.
8. Outdoor Visible Reflectance: Percent maximum As directed.
9. Factory apply manufacturer's standard opacifier to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA's "Engineering Standards Manual":

3.7 LAMINATED GLASS SCHEDULE

A. Glass Type GL-#: As directed Clear laminated glass with two plies of annealed or heat-strengthened, fully tempered, ultraclear annealed, ultraclear heat-strengthened or ultraclear fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
3. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
4. Safety glazing required.

B. Glass Type GL-#: As directed Tinted laminated glass with two plies of annealed, heat-strengthened or fully tempered float glass with outer ply tinted and inner ply clear.

1. Basis-of-Design Product: As directed.
2. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
3. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
4. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
5. Visible Light Transmittance: Percent minimum As directed.
6. Solar Heat Gain Coefficient: Maximum As directed.
7. Safety glazing required.

C. Glass Type GL-#: As directed Tinted laminated glass with two plies of clear annealed, heat-strengthened or fully tempered float glass and tinted interlayer.

1. Basis-of-Design Product: As directed.
2. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
3. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
4. Interlayer Color: As directed Blue-green, Bronze light or Gray.

5. Visible Light Transmittance: Percent minimum As directed.
6. Solar Heat Gain Coefficient: Maximum As directed.
7. Safety glazing required.

D. Glass Type GL-#: As directed Ceramic-coated, laminated vision glass with two plies of heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Outer Ply: As directed Clear, Ultraclear or Tinted float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Inner Ply: As directed Clear or Ultraclear float glass.
5. Ceramic Coating Color and Pattern: As selected by Architect from manufacturer's full range or Match Architect's samples.
6. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
7. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
8. Coating Location: As directed Second, Third or Fourth surface.
9. Visible Light Transmittance: Percent minimum As directed.
10. Solar Heat Gain Coefficient: Maximum As directed.
11. Safety glazing required.

E. Glass Type GL-#: Reflective-coated, laminated vision glass with two plies of heat-strengthened or fully tempered float glass with inner ply clear.

1. Basis-of-Design Product: As directed.
2. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).
3. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
4. Coating Color: As directed Gold, Pewter or Silver.
5. Outer Ply: As directed Clear or Tinted float glass.
6. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
7. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
8. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
9. Coating Location: As directed First, Second or Third surface.
10. Outdoor Visible Reflectance: Percent maximum As directed.
11. Visible Light Transmittance: Percent minimum As directed.
12. Solar Heat Gain Coefficient: Maximum As directed.
13. Low-Maintenance Coating: Pyrolytic coating on first surface.
14. Safety glazing required.

F. Glass Type GL-#: As directed Low-E-coated, laminated vision glass with two plies of clear annealed, heat-strengthened or fully tempered float glass.

1. Basis-of-Design Product: As directed.
2. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
3. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
4. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.

5. Visible Light Transmittance: Percent minimum As directed.
6. Solar Heat Gain Coefficient: Maximum As directed.
7. Safety glazing required.

G. Glass Type GL-#: Reflective-coated, laminated spandrel glass with two plies of heat-strengthened or fully tempered float glass with inner ply clear.

1. Basis-of-Design Product: As directed.
2. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
3. Coating Color: As directed Gold, Pewter or Silver.
4. Outer Ply: As directed Clear or Tinted float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
7. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
8. Coating Location: As directed First, Second or Third surface.
9. Outdoor Visible Reflectance: Percent maximum As directed.

3.8 INSULATING GLASS SCHEDULE

A. Glass Type GL-#: Clear insulating glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Annealed, Heat-strengthened or Fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Annealed, Heat-strengthened or Fully tempered float glass.
7. Winter Nighttime U-Factor: Maximum As directed.
8. Summer Daytime U-Factor: Maximum As directed.
9. Safety glazing required.

B. Glass Type GL-#: Ultraclear insulating glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Ultraclear annealed, heat-strengthened or fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Ultraclear annealed, heat-strengthened or fully tempered float glass.
7. Winter Nighttime U-Factor: Maximum As directed.
8. Summer Daytime U-Factor: Naximum As directed.
9. Safety glazing required.

C. Glass Type GL-#: Pyrolytic-coated, self-cleaning, low-maintenance, clear insulating glass.

1. Basis-of-Design Product: As directed Cardinal Glass Industries; Neat, Pilkington North America Inc.; Activ or Saint-Gobain Corporation; Bioclean.

2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: Pyrolytic-coated, self-cleaning, low-maintenance, clear annealed, heat-strengthened or fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Annealed, Heat-strengthened or Fully tempered float glass.
7. Winter Nighttime U-Factor: Maximum As directed.
8. Summer Daytime U-Factor: Maximum As directed.
9. Safety glazing required.

D. Glass Type GL-#: Low-E-coated, clear insulating glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Annealed, Heat-strengthened, Fully tempered, Ultraclear annealed, Ultraclear heat-strengthened or Ultraclear fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Annealed, Heat-strengthened, Fully tempered, Ultraclear annealed, Ultraclear heat-strengthened or Ultraclear fully tempered float glass.
7. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: Maximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

E. Glass Type GL-#: Pyrolytic-coated, self-cleaning, low-maintenance, low-E coated, clear insulating glass.

1. Basis-of-Design Product: Cardinal Glass Industries; Neat LoE Pilkington North America Inc.; Activ Energy Advantage Saint-Gobain Corporation; Bioclean Cool-Lite.
2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Pyrolytic-coated, self-cleaning, low-maintenance, clear annealed, heat-strengthened or fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Annealed, Heat-strengthened or Fully tempered float glass.
7. Low-E Coating: As directed Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: As directed aximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

F. Glass Type GL-#: Tinted insulating glass.

1. Basis-of-Design Product: As directed.

2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: Tinted annealed, heat-strengthened or fully tempered float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Interspace Content: As directed Air or Argon.
7. Indoor Lite: Clear annealed, heat-strengthened or fully tempered float glass.
8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: Maximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

G. Glass Type GL-#: Low-E-coated, tinted insulating glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
3. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: Tinted As directed annealed, heat-strengthened or fully tempered float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Interspace Content: As directed Air or Argon.
7. Indoor Lite: As directed Clear annealed, heat-strengthened or fully tempered float glass.
8. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
9. Winter Nighttime U-Factor: Maximum As directed.
10. Summer Daytime U-Factor: Maximum As directed.
11. Visible Light Transmittance: Percent minimum As directed.
12. Solar Heat Gain Coefficient: Maximum As directed.
13. Safety glazing required.

H. Glass Type GL-#: Ceramic-coated, insulating vision glass.

1. Basis-of-Design Product: As directed.
2. Ceramic Coating Color and Pattern: As selected by Architect from manufacturer's full range or Match Architect's samples.
3. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
4. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
5. Outdoor Lite: As directed Clear, Ultraclear, annealed, heat-strengthened or fully tempered float glass.
6. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
7. Interspace Content: As directed Air or Argon.
8. Indoor Lite: As directed Clear, Ultraclear, annealed, heat-strengthened or fully tempered float glass.
9. Coating Location: As directed Second, Third or Fourth surface.
10. Winter Nighttime U-Factor: Maximum As directed.
11. Summer Daytime U-Factor: Maximum As directed.
12. Visible Light Transmittance: Percent minimum As directed.
13. Solar Heat Gain Coefficient: Maximum As directed.
14. Safety glazing required.

I. Glass Type GL-#: Reflective-coated, insulating glass.

1. Basis-of-Design Product: As directed.
2. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).
3. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
4. Coating Color: As directed Gold, Pewter or Silver.
5. Overall Unit Thickness: As directed 1 inch (25 mm) or 5/8 inch (16 mm).
6. Minimum Thickness of Each Glass Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
7. Outdoor Lite: As directed Clear, Tinted, annealed, heat-strengthened or fully tempered float glass.
8. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
9. Interspace Content: As directed Air or Argon.
10. Indoor Lite: As directed Clear annealed, heat-strengthened or fully tempered float glass.
11. Coating Location: As directed First, Second or Third surface.
12. Outdoor Visible Reflectance: Percent maximum.
13. Winter Nighttime U-Factor: Maximum As directed.
14. Summer Daytime U-Factor: Maximum As directed.
15. Visible Light Transmittance: Percent minimum As directed.
16. Solar Heat Gain Coefficient: Maximum As directed.
17. Low-Maintenance Coating: Pyrolytic coating on first surface.
18. Safety glazing required.

J. Glass Type GL-#: As directed Ceramic or Silicone-coated, insulating spandrel glass.

1. Basis-of-Design Product: As directed.
2. Coating Color: As selected by Architect from manufacturer's full range or Match Architect's samples.
3. Overall Unit Thickness: 1 inch (25 mm).
4. Minimum Thickness of Each Glass Lite: As directed 5 mm or 6 mm.
5. Outdoor Lite: As directed Clear, Ultraclear, annealed, heat-strengthened or fully tempered float glass.
6. Interspace Content: As directed Air or Argon.
7. Indoor Lite: As directed Clear, Ultraclear, annealed, heat-strengthened or fully tempered float glass.
8. Coating Location: Fourth surface.
9. Winter Nighttime U-Factor: Maximum As directed.
10. Summer Daytime U-Factor: Maximum As directed.

K. Glass Type GL-#: As directed Ceramic or Silicone-coated, low-E, insulating spandrel glass.

1. Basis-of-Design Product: As directed.
2. Coating Color: As selected by Architect from manufacturer's full range, Match Architect's samples.
3. Overall Unit Thickness: 1 inch (25 mm).
4. Minimum Thickness of Each Glass Lite: As directed 5 mm or 6 mm.
5. Outdoor Lite: As directed Annealed, Heat-strengthened, Fully tempered, Ultraclear annealed, Ultraclear heat-strengthened or Ultraclear fully tempered float glass.
6. Interspace Content: As directed Air or Argon.

7. Indoor Lite: As directed Annealed, Heat-strengthened, Fully tempered, Ultraclear annealed, Ultraclear heat-strengthened or Ultraclear fully tempered float glass.
8. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
9. Opaque Coating Location: Fourth surface.
10. Winter Nighttime U-Factor: Maximum As directed.
11. Summer Daytime U-Factor: Maximum As directed.

L. Glass Type GL-#: As directed Ceramic-coated or Silicone-coated, tinted, insulating spandrel glass.

1. Basis-of-Design Product: As directed.
2. Coating Color: As selected by Architect from manufacturer's full range or Match Architect's samples.
3. Overall Unit Thickness: 1 inch (25 mm).
4. Minimum Thickness of Each Glass Lite: As directed 5 mm or 6 mm.
5. Outdoor Lite: Tinted As directed annealed, heat-strengthened or fully tempered float glass.
6. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
7. Interspace Content: As directed Air or Argon.
8. Indoor Lite: Clear annealed, heat-strengthened or fully tempered float glass.
9. Coating Location: Fourth surface.
10. Winter Nighttime U-Factor: Maximum As directed.
11. Summer Daytime U-Factor: Maximum As directed.

3.9 INSULATING-LAMINATED-GLASS SCHEDULE

A. Glass Type GL-#: Clear insulating laminated glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1-3/16 inch (30 mm), 1 inch (25 mm) or 3/4 inch (19 mm).
3. Minimum Thickness of Outdoor Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Heat-strengthened or Fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: Clear laminated glass with two plies of annealed, heat-strengthened or fully tempered float glass.
    a. Minimum Thickness of Each Glass Ply: As directed 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
    b. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
7. Winter Nighttime U-Factor: Maximum As directed.
8. Summer Daytime U-Factor: Maximum As directed.
9. Solar Heat Gain Coefficient: Maximum As directed.
10. Safety glazing required.

B. Glass Type GL-#: Low-E-coated, clear insulating laminated glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1-3/16 inch (30 mm), 1 inch (25 mm) or 3/4 inch (19 mm).
3. Minimum Thickness of Outdoor Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Heat-strengthened or Fully tempered float glass.
5. Interspace Content: As directed Air or Argon.
6. Indoor Lite: As directed Clear laminated glass with two plies of annealed, heat-strengthened, fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
    b. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).

7. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: Maximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

C. Glass Type GL-#: Tinted, insulating laminated glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1-3/16 inch (30 mm), 1 inch (25 mm) or 3/4 inch (19 mm).
3. Minimum Thickness of Outdoor Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.
4. Outdoor Lite: As directed Tinted heat-strengthened or fully tempered float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Interspace Content: As directed Air or Argon.
7. Indoor Lite: Clear laminated glass with two plies of annealed, heat-strengthened or fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm or 6 mm or As indicated.
    b. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).

8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: Maximum As directed.
10. Visible Light Transmittance: Percent minimum As directed.
11. Solar Heat Gain Coefficient: Maximum As directed.
12. Safety glazing required.

D. Glass Type GL-#: Low-E-coated, tinted, insulating laminated glass.

1. Basis-of-Design Product: As directed.
2. Overall Unit Thickness: As directed 1-3/16 inch (30 mm), 1 inch (25 mm) or 3/4 inch (19 mm).
3. Minimum Thickness of Outdoor Lite: As directed 3 mm, 4 mm, 5 mm or 6 mm.

4. Outdoor Lite: As directed Tinted heat-strengthened or fully tempered float glass.
5. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
6. Interspace Content: As directed Air or Argon.
7. Indoor Lite: Clear laminated glass with two plies of annealed, heat-strengthened or fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
    b. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).

8. Low-E Coating: As directed Pyrolytic on second, Pyrolytic on third, Sputtered on second, Sputtered on third or Pyrolytic or sputtered on second or third surface.
9. Winter Nighttime U-Factor: Maximum As directed.
10. Summer Daytime U-Factor: Maximum As directed.
11. Visible Light Transmittance: Percent minimum As directed.
12. Solar Heat Gain Coefficient: Maximum As directed.
13. Safety glazing required.

E. Glass Type GL-#: Reflective-coated, insulating laminated glass.

1. Basis-of-Design Product: As directed.
2. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).
3. Coating Type: As directed Pyrolytic or Sputter-coating (vacuum deposition process).
4. Coating Color: As directed Gold, Pewter or Silver.
5. Overall Unit Thickness: As directed 1-3/16 inch (30 mm) or 1 inch (25 mm).
6. Minimum Thickness of Outdoor Lite: 6 mm.
7. Outdoor Lite: As directed Clear, Tinted, heat-strengthened or fully tempered float glass.
8. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
9. Interspace Content: As directed Air or Argon.
10. Indoor Lite: Clear laminated glass with two plies of annealed, heat-strengthened or fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 3 mm, 4 mm, 5 mm, 6 mm or As indicated.
    b. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).

11. Coating Location: As directed First, Second or Third surface.
12. Outdoor Visible Reflectance: Percent maximum As directed.
13. Winter Nighttime U-Factor: Maximum As directed.
14. Summer Daytime U-Factor: Maximum As directed.
15. Visible Light Transmittance: Percent minimum As directed.
16. Solar Heat Gain Coefficient: Maximum As directed.
17. Low-Maintenance Coating: Pyrolytic coating on first surface.
18. Safety glazing required.

END OF SECTION 088000

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Patterned glass.
2. Coated glass.
3. Acid-etched glass.
4. Sandblasted glass.
5. Laminated glass.
6. Glass with decorative film overlay.
7. Glass with finished edges.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For decorative glass. Show fabrication and installation details.

C. Glass Samples: For each type of decorative glass, 12 inches (300 mm) square.

D. Decorative Glazing Schedule: List decorative glass types for each location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For decorative glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of decorative glass.

B. Preconstruction adhesion and compatibility test report.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each laminated decorative glass product, glass with decorative film overlay, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.8 WARRANTY

A. Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design decorative glass.

C. Structural Performance: Decorative glass installed adjacent to walking surfaces shall withstand the following design loads within limits and under conditions indicated:

1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. (730 N/m) applied horizontally to one panel at any point up to 42 inches (1067 mm) above the adjacent walking surface.
2. Base design on thickness at thinnest part of the glass.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers, GANA's "Laminated Glazing Reference Manual," and "GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC, the SGCC or another certification agency acceptable to authorities having jurisdiction, or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Ultraclear Float Glass: ASTM C1036, Type I, Class I, Quality-Q3, and with visible light transmission not less than 91 percent.

C. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

D. Fully Tempered Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

E. Heat-Strengthened Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

F. Patterned Glass: ASTM C1036, Type II, Class 1 (clear) or Class 2 (tinted) as indicated, Form 3; finish, pattern, and quality as indicated.

G. Tempered Patterned Glass: ASTM C1048, Kind FT (fully tempered), Type II, Class 1 (clear) or Class 2 (tinted) as indicated, Form 3; finish, pattern, and quality as indicated.

H. Patterned Ultraclear Glass: ASTM C1036, Type II, Class 1 (clear), Form 3, with visible light transmission not less than 91 percent; finish, pattern, and quality as indicated.

I. Tempered Patterned Ultraclear Glass: ASTM C1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3, with visible light transmission not less than 91 percent; finish, pattern, and quality as indicated.

J. Ceramic-Coated Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA's "Engineering Standards Manual."

K. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

L. Decorative Film Overlay: Translucent, dimensionally stable, cast PVC film, 2-mil- (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

2.5 GLAZING MATERIALS

A. Glazing Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 088000 "Glazing."

1. Colors: As selected by Architect from manufacturer's full range.

2.6 HARDWARE FOR GLASS INSTALLATION

A. Hardware: As directed Edge grips, Glass panel to ceiling clamps/connectors, Glass panel to floor clamps/connectors, Glass panel to wall clamps/connectors, Glass to glass panel clamp/connectors, Panel support bars, Stand-off display system with caps, Swivel fittings, Continuous top track or Continuous floor track.
1. Dimensions: As directed.
2. Material and Finish: As directed

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Gaskets: Manufacturer's standard, compatible with decorative glass type indicated.

D. Anchors and Inserts: Provide devices as required for hardware installation. Provide metal expansion-bolt devices for drilled-in-place anchors. As directed Provide galvanized or stainless-steel anchors and inserts for applications on inside face of exterior walls and where indicated.

2.7 DECORATIVE-GLASS FABRICATION

A. Edge Finishing: Finish edges smooth and polished, without chips, scratches, or warps.

1. Finished Edge: As directed Clean cut, Chamfered/Seamed/Swiped, Flat polished, Rounded polished, Beveled polished edge of width shown or Clean cut or flat grind vertical edges of butt-glazed lites in a manner that produces square edges with slight kerfs.

B. Lite Treatment: As directed Drilled, Notched, Cut out or Surface cut as indicated on Drawings with smooth, uniform edge.

C. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying, in pattern indicated on Drawings to or with graphic image as indicated on Drawings to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.2 INSTALLATION

A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.

B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.

C. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces and building structure.

3.3 GLAZING, GENERAL

A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."

3.4 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

3.5 DECORATIVE GLASS SCHEDULE

A. Decorative Glass Type GL-#: As directed Clear, Ultraclear, Tinted, patterned or tempered patterned glass, Finish F1 (patterned one side) or Finish F2 (patterned both sides), Quality-Q5 or 6.

1. Basis-of-Design Product: As directed.
2. Glass Thickness: As directed 4 mm, 5 mm or 6 mm.
3. Pattern: P1 (linear), P2 (geometric), P3 (random), P4 (special), As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.
4. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
5. Safety glazing required.

B. Decorative Glass Type GL-#: As directed Coated glass with decorative ceramic frit applied and heat-fused to glass surface or glass paint or ink applied to glass surface and cured.

1. Basis-of-Design Product: As directed.
2. Glass Type: As directed Clear, Ultraclear, Tinted, annealed, heat-strengthened or fully tempered float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Glass Thickness: As directed 4 mm, 5 mm, 6 mm.
5. Safety glazing required.
6. Coating Colors: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range or As indicated.
7. Pattern: Solid color, As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range or As indicated.

C. Decorative Glass Type GL-#: Acid-etched glass with decorative pattern evenly etched into glass.

1. Basis-of-Design Product: As directed.
2. Glass Type: As directed Clear, Ultraclear, Tinted, annealed or fully tempered float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Glass Thickness: As directed 4 mm, 5 mm or 6 mm.
5. Pattern: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range or As indicated.
6. Silicone Back Coating: Recommended by glass fabricator for shop application.
    a. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

D. Decorative Glass Type GL-#: Sandblasted glass with decorative pattern applied uniformly.

1. Basis-of-Design Product: As directed.
2. Glass Type: As directed Clear, Ultraclear, Tinted, annealed or fully tempered float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Glass Thickness: As directed Not less than, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm or 12 mm.
5. Pattern: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range or As indicated.
6. Antifingerprint Coating: Protective coating recommended and provided by glass fabricator.
7. Acid-Etched Finish: Acid etching the glass evenly, maintaining detail of sandblasted pattern.

E. Decorative Glass Type GL-#: Laminated glass.

1. Basis-of-Design Product:.
2. Construction: Two plies of As directed clear, ultraclear, tinted, annealed, heat-strengthened or fully tempered float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Thickness of Each Glass Ply: As directed 3 mm, 4 mm, 5 mm or 6 mm.
5. Construction: Laminate glass with PVB interlayer orcast-in-place and cured, transparent, resin interlayer to comply with interlayer manufacturer's written instructions.
6. Interlayer Thickness: As directed 0.030 inch (0.76 mm), 0.060 inch (1.52 mm) or 0.090 inch (2.29 mm).
7. Interlayer Color and Pattern: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.
8. Safety glazing required.
9. Visible Light Transmittance of Interlayer: Percent minimum As directed.
10. Sound Transmission Requirements: Sound transmission loss performance is tested according to ASTM E90, determined by ASTM E413, and rated for Sound Transmission Class (STC) plus or minus 1 of 35 or 40 As directed.

F. Decorative Glass Type GL-#: Glass with decorative film overlay.

1. Basis-of-Design Product: As directed.
2. Glass Type: As directed Clear, Ultraclear, Tinted, annealed, heat-strengthened or fully tempered float glass.
3. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
4. Glass Thickness: As directed 4.0 mm, 5.0 mm or 6.0 mm.
5. Safety glazing required.
6. Use: Suitable for exterior and interior applications.
7. Outdoor Durability: Not less than five years.
8. Patterns: As indicated by manufacturer's designations, Match Architect's samples, As selected by Architect from manufacturer's full range or As indicated.

END OF SECTION 088113

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.
2. Film-backed, Laminated or Tempered glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

D. Samples: For each type of the following:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction test report.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion or manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As directed.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.

B. Annealed Monolithic Glass Mirrors: As directed Mirror Select or Glazing Quality, clear, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.

1. Nominal Thickness: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm or As indicated.

C. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm or As indicated.

D. Laminated Mirrors: ASTM C1172, Type II.

1. Glass for Outer Lite: As directed Annealed float glass, Mirror Select or Glazing Quality, clear or ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
2. Nominal Thickness for Outer Lite: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm or As indicated.
3. Glass for Inner Lite: Annealed float glass; ASTM C1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
4. Nominal Thickness: 3.0 mm, 4.0 mm, 5.0 mm, 6.0 mm or As indicated.
5. Interlayer: 0.030-inch- (0.76-mm-) thick, clear polyvinyl-butyral.

E. Safety Glazing Products: As directed For film-backed, laminated or tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating approved by mirror manufacturer.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

3. Finish: As directed Clear or Gold bright anodized.

B. Mirror Bottom Clips: As indicated.

C. Mirror Top Clips: As indicated.

D. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: As directed Flat polished, Rounded polished, Flat high-polished, Rounded high-polished or Beveled polished edge of width shown. Seal edges of mirrors with edge sealer.

C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 088400 - PLASTIC GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monolithic acrylic glazing.
2. Monolithic polycarbonate glazing.
3. Multiwalled structured polycarbonate glazing.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on plastic glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Plastic Glazing Samples: For each color and finish of plastic glazing indicated.

D. Glazing Accessory Samples: For gaskets and sealants.

E. Plastic Glazing Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

B. Research/Evaluation Reports: For plastic glazing.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plastic glazing to include in maintenance manuals.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each plastic glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and plastic glazing matching those submitted.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Abrasion- and UV-Resistant, Monolithic or Multiwalled Structured Polycarbonate As directed: Manufacturer agrees to replace polycarbonate products that break or develop defects from normal use that are attributable to manufacturing process and not to practices for maintaining and cleaning plastic glazing contrary to manufacturer's written instructions. Defects include coating delamination, haze, excessive yellowing, and loss of light transmission beyond the limits stated in plastic glazing manufacturer's standard form.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Windborne-Debris Impact Resistance: As directed Exterior plastic glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

B. Safety Glazing: Plastic glazing shall comply with 16 CFR 1201, Category II.

1. Labeling: Permanently mark plastic glazing with certification label of an agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of plastic, thickness, and safety glazing standard with which plastic glazing complies.

C. Fire-Test-Response Characteristics of Plastic Glazing: As determined by testing plastic glazing by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F (343 deg C) or higher when tested according to ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke density of 75 or less when tested according to ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch (25 mm) or less when tested according to ASTM D635 at a nominal thickness of 0.060 inch (1.52 mm) or thickness indicated for the Work, where Class CC1 is indicated.

4. Burning rate of 2.5 in./min. (1.06 mm/s) or less when tested according to ASTM D635 at a nominal thickness of 0.060 inch (1.52 mm) or thickness indicated for the Work, where Class CC2 is indicated.
5. Flame-spread index of not less than that indicated when tested according to ASTM E84.

2.2 PLASTIC GLAZING, GENERAL

A. Glazing Publication: Comply with published instructions of plastic glazing manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

2.3 MONOLITHIC ACRYLIC GLAZING

A. Plastic Glazing Type PG-#: As directed Transparent acrylic sheet; ASTM D4802, Category A-1 (cell cast), Category A-2 (continuously cast) or Category B-1 (continuously manufactured), Finish 1 (smooth or polished), Type UVF (UV filtering).
1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
2. Color: Colorless or As selected by Architect from manufacturer's full range.
3. Combustibility Class: CC2.

B. Plastic Glazing Type PG-#: As directed Coated, transparent acrylic sheet; ASTM D4802, Category A-1 (cell cast), Category A-2 (continuously cast) or Category B-1 (continuously manufactured), Finish 3 (abrasion-resistant coating) with coating on one side or both sides, Type UVF (UV filtering).
1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
2. Color: Colorless or As selected by Architect from manufacturer's full range.
3. Combustibility Class: CC2.

C. Plastic Glazing Type PG-#: As directed Translucent acrylic sheet; ASTM D4802, Category A-1 (cell cast), Category A-2 (continuously cast) or Category B-1 (continuously manufactured), Finish 1 (smooth or polished), Type UVF (UV filtering).
1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
2. Color: White, with visible light transmittance of not more than 50 percent for 0.117-inch-(2.9-mm-) thick sheet, measured according to ASTM D1003 or As selected by Architect from manufacturer's full range.
3. Combustibility Class: CC2.

D. Plastic Glazing Type PG-#: Patterned acrylic sheet; ASTM D4802, Category A-1 (cell cast), Finish 2 (patterned), Type UVF (UV filtering).
1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
2. Pattern: Matte finish or As selected by Architect from manufacturer's full range.
3. Color: Transparent colorless, Translucent white or As selected by Architect from manufacturer's full range.

4. Combustibility Class: CC2.

2.4 MONOLITHIC POLYCARBONATE GLAZING

A. Plastic Glazing Type PG-#: Polycarbonate sheet; ASTM C1349, Appendix X1, Type I (standard, UV stabilized), with a polished finish.
   1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
   2. Color: Transparent colorless or As selected by Architect from manufacturer's full range.
   3. Combustibility Class: CC1.
   4. Flame-Spread Index: As directed 25, 75 or 200 or less.

B. Plastic Glazing Type PG-#: Coated polycarbonate sheet; ASTM C1349, Appendix X1, Type II (coated mar-resistant, UV stabilized), with coating on both sides.
   1. Nominal Thickness: As directed 0.093 inch (2.5 mm), 0.118 inch (3 mm), 0.177 inch (4.5 mm) or 0.236 inch (6 mm).
   2. Color: Transparent colorless or As selected by Architect from manufacturer's full range.
   3. Combustibility Class: CC1.
   4. Flame-Spread Index: As directed 25, 75 or 200 or less.

2.5 MULTIWALLED STRUCTURED POLYCARBONATE GLAZING

A. Multiwalled Structured Polycarbonate Sheet: Manufacturer's standard polycarbonate extruded shape with smooth, flat exterior surfaces and internal ribbing.
   1. Nominal Thickness: As directed 5/16 inch (8 mm), 3/8 inch (10 mm), 5/8 inch (16 mm), 3/4 inch (20 mm) or 1 inch (25 mm).
   2. UV Resistance: As directed Not required, On outer surface or On both surfaces.
   3. Color: Transparent colorless or As selected by Architect from manufacturer's full range.
   4. Combustibility Class: As directed CC1 or CC2.
   5. Flame-Spread Index: As directed 25, 75 or 200 or less.

2.6 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets, EPDM, ASTM C864 or silicone, ASTM C1115; and of profile and hardness required to maintain watertight seal.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM or silicone gaskets complying with ASTM C509, Type II, black; and of profile and hardness required to maintain watertight seal.

2.7 GLAZING SEALANTS

A. General:

   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including plastic glazing products and glazing channel

substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Applications: As directed.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Applications: As directed.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Applications: As directed.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. As directed Applications: As directed.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: EPDM or silicone as required for compatibility with glazing sealant and plastic glazing, and of hardness recommended by plastic glazing manufacturer for application indicated.

C. Compressible Filler Rods: Closed cell of waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5- to 10-psi (35- to 70-kPa) compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of plastic glazing materials, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publication.

B. Glazing channel dimensions indicated on Drawings are designed to provide the necessary bite on plastic glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust plastic glazing lites during installation to ensure that bite is equal on all sides.

C. Sand or scrape cut edges of plastic glazing to provide smooth edges, free of chips and hairline cracks.

D. Remove burrs and other projections from glazing channel surfaces.

E. Protect plastic glazing surfaces from abrasion and other damage during handling and installation, according to the following requirements:

1. Retain plastic glazing manufacturer's protective covering or protect by other methods according to plastic glazing manufacturer's written instructions.
2. Remove covering at border of each piece before glazing; remove remainder of covering immediately after installation where plastic glazing is exposed to sunlight or where other conditions make later removal difficult.

F. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

G. Install elastomeric setting blocks in sill channels, sized and located to comply with referenced glazing publication, unless otherwise instructed by plastic glazing manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

H. Provide edge blocking to comply with referenced glazing publication unless otherwise instructed by plastic glazing manufacturer.

3.3 TAPE GLAZING

A. Install tapes continuously, but not in one continuous length. Do not stretch tapes to make them fit opening.

B. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

C. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant recommended by tape manufacturer.

D. Apply heel bead of glazing sealant.

E. Center plastic glazing lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

F. Apply cap bead of glazing sealant over exposed edge of tape.

3.4 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended in writing by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between plastic glazing and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center plastic glazing lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in plastic glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers between plastic glazing lites and glazing stops to maintain plastic glazing face clearances and to prevent sealant from extruding into glazing channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to plastic glazing and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from plastic glazing.

3.6 CLEANING AND PROTECTION

A. Protect plastic glazing from contact with contaminating substances from construction operations. If, despite such protection, contaminating substances do come into contact with plastic glazing, remove immediately and wash plastic glazing according to plastic glazing manufacturer's written instructions.

B. Remove and replace plastic glazing that is damaged during construction period.

END OF SECTION 088400

SECTION 088813 - FIRE-RESISTANT GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection-rated glazing.
2. Fire-resistance-rated glazing.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Glass Samples: For each type of glass product; 12 inches (300 mm) square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Double Glazing Units with Clear Gel Fill: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of double glazing units with clear gel fill is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is the leakage of gel fill from units, air bubbles within units, or obstruction of vision by contamination or deterioration of gel.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council, the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.

D. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.3 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.

C. Fire-Protection-Rated Tempered Glass: As directed 6-mm, 10-mm or 12-mm thickness, fire-protection-rated tempered glass; and complying with 16 CFR 1201, Category II.

D. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 5-mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

E. Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; and complying with 16 CFR 1201, Category II.

F. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.

2.4 FIRE-RESISTANCE-RATED GLAZING

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

C. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.

D. Double Glazing Units with Clear Gel Fill: Double glazing units made from two lites of uncoated, fully tempered, ultraclear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent gel; and complying with 16 CFR 1201, Category II.

2.5 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
   1. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 GLAZING

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

3.3 FIRE-PROTECTION-RATED GLAZING SCHEDULE

A. Glass Type FPGL-#: 20-minute fire-protection-rated glazing without hose-stream test; fire-protection-rated tempered glass, film-faced ceramic glazing, laminated ceramic glazing or laminated glass with intumescent interlayers.

B. Glass Type FPGL-#: As directed 20-minute fire-protection-rated glazing with hose-stream test; film-faced ceramic glazing, laminated ceramic glazing or laminated glass with intumescent interlayers.

C. Glass Type FPGL-#: As directed 45-minute fire-protection-rated glazing; film-faced ceramic glazing, laminated ceramic glazing or laminated glass with intumescent interlayers.

D. Glass Type FPGL-#: As directed 45-minute, 60-minute or 90-minute fire-protection-rated glazing with 450 deg F (250 deg C) temperature-rise limitation; laminated glass with intumescent interlayers.

3.4 FIRE-RESISTANCE-RATED GLAZING SCHEDULE

A. Glass Type FRGL-#: As directed 60-minute, 90-minute or 120-minute fire-resistance-rated glazing with 450 deg F (250 deg C) temperature-rise limitation; laminated glass with intumescent interlayers, or double glazing units with clear gel fill.

END OF SECTION 088813

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes monolithic polycarbonate, laminated glass, laminated polycarbonate, glass-clad polycarbonate, laminated glass and polycarbonate, insulating security glazing and air-gap security glazing.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. As directed

C. Security Glazing Samples: For each type of security glazing; 12 inches (300 mm) square.

D. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

E. Delegated-Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of security glazing, for tests performed by a qualified testing agency.

B. Preconstruction adhesion and compatibility test reports.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Coated Glass: Manufacturer agrees to replace coated glass that deteriorates within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated glass that deteriorates within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Polycarbonate Sheet: Manufacturer agrees to replace polycarbonate sheet that deteriorates within specified warranty period. Deterioration of polycarbonate sheet is defined as defects developed from normal use that are not attributed to maintaining and cleaning polycarbonate sheet contrary to manufacturer's written instructions. Defects include yellowing and loss of light transmission.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Laminated Polycarbonate: Manufacturer agrees to replace laminated polycarbonate that deteriorates within specified warranty period. Deterioration of laminated polycarbonate is defined as defects developed from normal use that are not attributed to maintaining and cleaning laminated polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced standard, yellowing, and loss of light transmission.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

E. Manufacturer's Special Warranty for Glass-Clad Polycarbonate: Manufacturer agrees to replace glass-clad polycarbonate that deteriorates within specified warranty period. Deterioration of glass-clad polycarbonate is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate contrary to

manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

F. Manufacturer's Special Warranty for Laminated Glass and Polycarbonate: Manufacturer agrees to replace laminated glass and polycarbonate that deteriorates within specified warranty period. Deterioration of laminated glass and polycarbonate is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass and polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.

1. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

G. Manufacturer's Special Warranty on Insulating Security Glazing: Manufacturer agrees to replace insulating security glazing that deteriorates within specified warranty period. Deterioration of insulating security glazing is defined as defects in individual lites developed from normal use or failure of hermetic seal under normal use. Deterioration does not include defects in individual lites or failure of hermetic seal that is attributed to glass breakage or to maintaining and cleaning insulating security glazing contrary to manufacturer's written instructions.

1. Defects in coated-glass lites include peeling, cracking, and other indications of deterioration in coating.
2. Defects in laminated-glass lites include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
3. Defects in glass-clad polycarbonate lites include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.
4. Evidence of hermetic seal failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glazing.
5. Warranty Period: As directed Five or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design security glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated.

1. Design Procedure for Glass: ASTM E1300 and ICC's International Building Code.
2. Design Wind Pressures: As indicated on Drawings.

3. Design Snow Loads: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Windborne-Debris Impact Resistance: As directed Exterior security glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 1, 2, 3 or 4 for basic or enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.3 m) above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.2 SECURITY GLAZING, GENERAL

A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

C. Safety Glazing Labeling: As directed Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council, the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

D. Insulating Glazing Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

E. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F (343 deg C) or more when tested according to ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke-Developed Index of 450 or less when tested according to ASTM E84, or smoke density of 75 or less when tested according to ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch (25 mm) or less when tested according to ASTM D635 at a nominal thickness of 0.060 inch (1.52 mm) or thickness indicated for the Work.

F. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar-Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

C. Chemically Strengthened Glass: As directed Annealed float glass is chemically strengthened to comply with ASTM C1422, Surface Compression Level 1, Level 2, Level 3, Level 4 or Level 5 and Case Depth Level A, Level B, Level C, Level D, Level E or Level F.

D. Reflective-Coated Vision Glass: As directed ASTM C1376, Kind CV (coated vision glass), coated by pyrolytic process or vacuum deposition (sputter-coating) process, and complying with other requirements specified.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
2. Interlayer Color: Clear unless otherwise indicated.

2.5 POLYCARBONATE SECURITY GLAZING

A. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.

B. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C1349 for maximum allowable laminating process blemishes and haze.

C. Glass-Clad Polycarbonate: ASTM C1349.

D. Laminated Glass and Polycarbonate: ASTM C1349.

2.6 INSULATING SECURITY GLAZING

A. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace, qualified according to ASTM E2190

1. Sealing System: Dual seal.
2. Spacer: As directed Manufacturer's standard spacer material and construction, Aluminum with mill or clear anodic finish, Aluminum with black, color anodic finish, Aluminum with bronze, color anodic finish, Aluminum with powdered metal paint finish in color selected by Architect, Galvanized steel, Stainless steel, Polypropylene-covered stainless steel in color selected by Architect, Thermally broken aluminum, Nonmetallic laminate or Nonmetallic tube.

2.7 AIR-GAP SECURITY GLAZING

A. Air-Gap Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer Specifications: Manufacturer's standard rigid spacer material and construction.

2.8 SPALL-RESISTANT FILM

A. Spall-Resistant Film: Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.

B. Laminating Process: Factory laminate spall-resistant film to glazing assemblies to produce laminated lites free of foreign substances, air, and glass pockets.

2.9 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Applications: As directed.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Applications: As directed.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Applications: As directed.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. As directed Applications: As directed.

F. Security Sealant: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement complying with ASTM C920, Grade NS, Class 12.5 or 25, Use NT, and with a Shore A hardness of at least 45 when tested according to ASTM C661.

2.10 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.11 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.12 FABRICATION OF SECURITY GLAZING

A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches (1270 mm).

G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to security glazing and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial washaway from security glazing.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter.

1. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

3.6 LAMINATED-GLASS SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG- As directed, Clear laminated glass, Tinted laminated glass, Clear reflective-coated laminated glass or Tinted reflective-coated laminated glass.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
3. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
4. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
5. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG, Level 8-SG according to UL 752.
6. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.

c. Peak Pressure: As directed.
d. Positive Phase Impulse: As directed.

7. Maximum Overall Unit Thickness: As directed.
8. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
9. Tinted Glass Location: Outer ply.
10. Coating Color: As directed Gold, Pewter or Silver.
11. Coating Location: As directed Second, Third or Fifth surface.
12. Overall Visible Light Transmittance: As directed.
13. Outdoor Visible Reflectance: Percent maximum As directed.
14. Winter Nighttime U-Factor: Maximum value As directed.
15. Summer Daytime U-Factor: Maximum value As directed.
16. Solar-Heat-Gain Coefficient: Maximum value As directed.
17. Provide safety glazing labeling.

B. Security Glazing Type SG-#: Tinted reflective-coated laminated glass with clear glass and tinted interlayer.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
3. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
4. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
5. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
6. Blast Resistance:

   a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
   b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
   c. Peak Pressure: As directed.
   d. Positive Phase Impulse: As directed.

7. Maximum Overall Unit Thickness: As directed.
8. Interlayer Color: As directed Clear, Blue-green, Bronze light or Gray.
9. Coating Color: As directed Gold, Pewter or Silver.
10. Coating Location: As directed Second, Third or Fifth surface.
11. Overall Visible Light Transmittance: As directed.
12. Outdoor Visible Reflectance: Percent maximum As directed.
13. Winter Nighttime U-Factor: Maximum value As directed.
14. Summer Daytime U-Factor: Maximum value As directed.
15. Solar-Heat-Gain Coefficient: Maximum value As directed.
16. Provide safety glazing labeling.

3.7 MONOLITHIC POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: Monolithic polycarbonate with mar-resistant coating on both surfaces.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

    a. As directed.

2. Detention Security Grade: As directed Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Thickness: As directed 3/8 inch (9.25 mm) or 1/2 inch (12.7 mm).

3.8 LAMINATED-POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: Laminated polycarbonate.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

    a. As directed.

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test or warm-temperature impact test and torch and small blunt impactor test.
3. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
4. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
5. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
    c. Peak Pressure: As directed.
    d. Positive Phase Impulse: As directed.

6. Maximum Overall Unit Thickness: As directed.

3.9 GLASS-CLAD POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: As directed Clear symmetrical glass-clad polycarbonate, Tinted symmetrical glass-clad polycarbonate, Clear reflective-coated symmetrical glass-clad polycarbonate or Tinted reflective-coated symmetrical glass-clad polycarbonate.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

    a. As directed.

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
4. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
5. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
6. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
7. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
    c. Peak Pressure: As directed.
    d. Positive Phase Impulse: As directed.

8. Maximum Overall Unit Thickness: As directed.
9. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
10. Tinted Glass Location: Outer ply.
11. Coating Color: As directed Gold, Pewter or Silver.
12. Coating Location: As directed Second, Third or Fifth surface.
13. Overall Visible Light Transmittance: As directed.
14. Outdoor Visible Reflectance: Percent maximum as directed.
15. Winter Nighttime U-Factor: Maximum value as directed.
16. Summer Daytime U-Factor: Maximum value as directed.
17. Solar-Heat-Gain Coefficient: Maximum value as directed.
18. Provide safety glazing labeling.

3.10 LAMINATED-GLASS-AND-POLYCARBONATE SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: As directed Nonsymmetrical clear, tinted or reflective-coated laminated glass and polycarbonate with glass plies on the attack or threat side and polycarbonate plies on the witness side.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

    a. As directed.

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
4. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
5. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
6. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
7. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
    c. Peak Pressure: As directed.
    d. Positive Phase Impulse:.

8. Maximum Overall Unit Thickness: As directed.
9. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
10. Tinted Glass Location: Outer glass ply.
11. Coating Color: As directed Gold, Pewter or Silver.
12. Coating Location: As directed Second, Third or Fifth surface.
13. Overall Visible Light Transmittance: As directed.
14. Outdoor Visible Reflectance: Percent maximum as directed.
15. Winter Nighttime U-Factor: Maximum value as directed.
16. Summer Daytime U-Factor: Maximum value as directed.
17. Solar-Heat-Gain Coefficient: Maximum value as directed.
18. Provide safety glazing labeling.

3.11 INSULATING SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: As directed Clear insulating security glazing, Tinted insulating security glazing, Reflective-coated, clear insulating security glazing or Reflective-coated, tinted insulating security glazing. Outdoor lite is made of monolithic glass and indoor lite is made of glass-clad polycarbonate.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

    a. As directed.

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Interspace Content: As directed Air or Argon.

4. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
5. Tinted Glass Location: Outdoor lite.
6. Coating Color: As directed Gold, Pewter or Silver.
7. Coating Location: As directed Second, Third or Fifth surface.
8. Overall Visible Light Transmittance: Percent minimum As directed.
9. Outdoor Visible Reflectance: Percent maximum As directed.
10. Winter Nighttime U-Factor: Maximum value As directed.
11. Summer Daytime U-Factor: Maximum value As directed.
12. Solar-Heat-Gain Coefficient: Maximum value As directed.
13. Provide safety glazing labeling.

B. Security Glazing Type SG-#: As directed Low-e-coated, clear insulating security glazing or Low-e-coated, tinted insulating security glazing. Outdoor lite is made of monolithic glass and indoor lite is made of glass-clad polycarbonate.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Interspace Content: As directed Air or Argon.
4. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
5. Tinted Glass Location: Outer lite.
6. Low-E Coating: As directed Pyrolytic on second surface, Pyrolytic on third surface, Sputtered on second surface or Sputtered on third surface.
7. Overall Visible Light Transmittance: Percent minimum As directed.
8. Winter Nighttime U-Factor: Maximum As directed.
9. Summer Daytime U-Factor: Maximum As directed.
10. Solar-Heat-Gain Coefficient: Maximum As directed.
11. Provide safety glazing labeling.

C. Security Glazing Type SG-#: As directed Clear insulating security glazing, Tinted insulating security glazing, Reflective-coated, clear insulating security glazing or Reflective-coated, tinted insulating security glazing. Outdoor lite is made of laminated glass and indoor lite made of is glass-clad polycarbonate with spall-resistant film on inside face.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
4. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.

5. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
6. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
7. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
    c. Peak Pressure: As directed.
    d. Positive Phase Impulse: As directed.

8. Interspace Content: As directed Air or Argon.
9. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
10. Tinted Glass Location: As directed Outer or Inner ply of outdoor lite.
11. Coating Color: As directed Gold, Pewter or Silver.
12. Coating Location: As directed Second, Third or Fifth surface.
13. Overall Visible Light Transmittance: Percent minimum As directed.
14. Outdoor Visible Reflectance: Percent maximum As directed.
15. Winter Nighttime U-Factor: Maximum As directed.
16. Summer Daytime U-Factor: Maximum As directed.
17. Solar-Heat-Gain Coefficient: Maximum As directed.
18. Provide safety glazing labeling.

D. Security Glazing Type SG-#: Low-e-coated, clear insulating security glazing or Low-e-coated, tinted insulating security glazing. Outdoor lite is made of laminated glass and indoor lite is made of glass-clad polycarbonate with spall-resistant film on inside face.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Detention Security Grade: As directed Grade 1, Grade 2, Grade 3 or Grade 4 according to ASTM F1915 cold-temperature impact test, warm-temperature impact test and torch and small blunt impactor test.
3. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
4. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
5. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
6. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
7. Blast Resistance:

a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
c. Peak Pressure: As directed.
d. Positive Phase Impulse: As directed.

8. Interspace Content: As directed Air or Argon.
9. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
10. Tinted Glass Location: Outer lite.
11. Low-E Coating: As directed Pyrolytic on second surface, Pyrolytic on third surface, Sputtered on second surface or Sputtered on third surface.
12. Overall Visible Light Transmittance: Percent minimum As directed.
13. Winter Nighttime U-Factor: Maximum As directed.
14. Summer Daytime U-Factor: Maximum As directed.
15. Solar-Heat-Gain Coefficient: Maximum As directed.
16. Provide safety glazing labeling.

3.12 AIR-GAP SECURITY GLAZING SCHEDULE

A. Security Glazing Type SG-#: As directed Clear air-gap security glazing, Tinted air-gap security glazing, Clear reflective-coated air-gap security glazing or Tinted reflective-coated air-gap security glazing. Outdoor lite is made of laminated glass and indoor lite is made of laminated polycarbonate.

1. Products: As directed Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Forced-Entry Resistance: As directed Class I, Class II, Class III, Class IV or Class V according to ASTM F1233.
3. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
4. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
5. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
6. Blast Resistance:

a. Hazard Rating: As directed No hazard, Minimal hazard, very low hazard, Low hazard or High hazard according to ASTM F1642.
b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
c. Peak Pressure: As directed.
d. Positive Phase Impulse: As directed.

7. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
8. Tinted Glass Location: As directed Outer or Inner ply of outdoor lite.
9. Coating Color: As directed Gold, Pewter or Silver.
10. Coating Location: As directed Second, Third or Fifth surface.

11. Overall Visible Light Transmittance: Percent minimum As directed.
12. Outdoor Visible Reflectance: Percent maximum As directed.
13. Winter Nighttime U-Factor: Maximum As directed.
14. Summer Daytime U-Factor: Maximum As directed.
15. Solar-Heat-Gain Coefficient: Maximum As directed.
16. Provide safety glazing labeling.

B. Security Glazing Type SG-#: As directed Low-e-coated, clear air-gap security glazing or Low-e-coated, tinted air-gap security glazing. Outdoor lite is made of laminated glass and indoor lite is made of laminated polycarbonate.

1. Products: Subject to compliance with requirements, provide the following, provide one of the following or available products that may be incorporated into the Work include, but are not limited to, the following:

2. Forced-Entry Resistance: As directed Class I, Class II,Class III, Class IV, Class V according to ASTM F1233.
3. Forced-Entry Resistance: As directed Level I, Level II, Level III, Level IV or Level V according to HPW-TP-0500.03.
4. Ballistic Resistance: As directed Class/Level HG1, Class/Level HG2, Class/Level HG3, Class/Level HG4, Class/Level SMG, Class/Level R1, Class/Level R2, Class/Level R3, Class/Level R4-AP, Class/Level SH1 or Class/Level SH2 according to ASTM F1233.
5. Ballistic Resistance: As directed Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7, Level 8, Level 1-SG, Level 2-SG, Level 3-SG, Level 4-SG, Level 5-SG, Level 6-SG, Level 7-SG or Level 8-SG according to UL 752.
6. Blast Resistance:

    a. Hazard Rating: As directed No hazard, Minimal hazard, Very low hazard, Low hazard or High hazard according to ASTM F1642.
    b. Performance Condition: As directed 1, 2, 3a, 3b, 4 or 5 according to GSA-TS01.
    c. Peak Pressure: As directed.
    d. Positive Phase Impulse: As directed.

7. Glass Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.
8. Tinted Glass Location: As directed Outer or Inner ply of outdoor lite.
9. Low-E Coating: As directed Pyrolytic on second surface, Pyrolytic on third surface, Sputtered on second surface or Sputtered on third surface.
10. Overall Visible Light Transmittance: Percent minimum As directed.
11. Winter Nighttime U-Factor: Maximum As directed.
12. Summer Daytime U-Factor: Maximum As directed.
13. Solar Heat-Gain Coefficient: Maximum As directed.
14. Provide safety glazing labeling.

END OF SECTION 088853

SECTION 089116 - OPERABLE WALL LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes operable, extruded-aluminum and formed-metal louvers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:
1. As directed.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Wiring Diagrams: For power, signal, and control wiring for motorized operable louvers.

D. Samples: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M.
2. AWS D1.3/D1.3M.
3. AWS D1.6/D1.6M.

1.5 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Warranty Period: As directed Five, 10 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures to the face of the building shall be considered to act normal.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
2. Wind Loads: As directed Determine loads based on a uniform pressure of 20 lbf/sq. ft. (957 Pa) or 30 lbf/sq. ft. (1436 Pa), acting inward or outward.
3. Wind Loads: Determine loads based on pressures indicated below:

    a. Corner Zone: As directed Within a certain distance of building corners, uniform pressure of As directed, acting inward, and As directed acting outward.
    b. Other Than Corner Zone: As directed Uniform pressure As directed, acting inward, and As directed acting outward.

C. Seismic Performance: As indicated on Drawings.

D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Design earthquake spectral response acceleration, short period (Sds) for Project As directed.
2. Component Importance Factor: As directed 1.5 or 1.0.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

F. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

2.2 OPERABLE EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction and Operation: Provide operable louvers with extruded-aluminum frames and blades of not less than 0.080-inch (2.03-mm) nominal thickness, and with operating mechanisms to suit louver sizes.

1. Hand operation with push bars.
2. Crank operation with removable-crank operator in sill or jamb.
3. Chain operation with tension spring, wall clip, pull chain, and 160 deg F (71 deg C) fusible link.
4. As directed Motor operation with two-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch or two-direction, 110-V, 60-Hz motor and limit switches; equipped with frame-mounted switch, remote-mounted switch with indicator light or terminals for controlling devices.
5. As directed Pneumatic piston operation for use with 80- to 100-psi (550- to 690-kPa) compressed air for two-position or modulating operation; power open, power close with spring-return fail-safe.

B. Single-Blade Operable Louver:
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm).
2. Blade Type: As directed Drainable or Plain.
3. Accessories: Equip louvers as follows:

    a. Vinyl blade-edge gaskets for each louver blade.
    b. As directed Stainless-steel jamb seals or vinyl blade-end gaskets.

4. Louver Performance Ratings:

    a. Free Area: As directed Not less than 6.5 sq. ft. (0.60 sq. m), 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m) or 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: As directed Not less than 500 fpm (2.5 m/s), 600 fpm (3.0 m/s), 700 fpm (3.6 m/s), 800 fpm (4.1 m/s), 900 fpm (4.6 m/s) or 1000 fpm (5.1 m/s).
    c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 500-fpm (2.5-m/s), 600-fpm (3.0-m/s), 700-fpm (3.6-m/s), 800-fpm (4.1-m/s) or 900-fpm (4.6-m/s) free-area exhaust or intake velocity.
    d. Air Leakage: Not more than 3.5 cfm/sq. ft. (17.8 L/s per sq. m) of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with operable louver blades closed.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Dual-Blade Operable Louver: Fixed drainable blades and operable plain blades combined in single frame.
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm), overall.
2. Fixed Drainable-Blade Angle: As directed 30, 35, 37.5 or 45 degrees.
3. Louver Performance Ratings:

a. Free Area: As directed Not less than 6.0 sq. ft. (0.56 sq. m), 6.5 sq. ft. (0.60 sq. m), 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m) or 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
b. Point of Beginning Water Penetration: As directed Not less than 750 fpm (3.8 m/s), 800 fpm (4.1 m/s), 850 fpm (4.3 m/s), 900 fpm (4.6 m/s), 950 fpm (4.8 m/s) or 1000 fpm (5.1 m/s).
c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 750-fpm (3.8-m/s), 800-fpm (4.1-m/s), 850-fpm (4.3-m/s) or 900-fpm (4.6-m/s) free-area exhaust or intake velocity.
d. Air Leakage: Not more than 1.5 cfm/sq. ft. (7.6 L/s per sq. m) of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with operable louver blades closed.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 OPERABLE FORMED-METAL LOUVERS

A. Louver Operation: Provide operable louvers with operating mechanisms to suit louver sizes.

1. Hand operation with push bars.
2. Crank operation with removable-crank operator in sill or jamb.
3. Chain operation with tension spring, wall clip, pull chain, and 160 deg F (71 deg C) fusible link.
4. As directed Motor operation with two-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch or two-direction, 110-V, 60-Hz motor and limit switches; equipped with frame-mounted switch, remote-mounted switch with indicator light or terminals for controlling devices.
5. Pneumatic piston operation for use with 80- to 100-psi (550- to 690-kPa) compressed air for two-position or modulating operation; power open, power close with spring-return fail-safe.

B. Single-Blade Operable Louver:
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm).
2. Blade Type: As directed Drainable or Plain.
3. Frame and Blade Material and Nominal Thickness: As directed Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades, 0.052 inch (1.32 mm) or 0.064 inch (1.63 mm).
4. Frame and Blade Material and Nominal Thickness: As directed Stainless-steel sheet, not less than 0.050 inch (1.27 mm) or 0.062 inch (1.59 mm).
5. Accessories: Equip louvers as follows:

a. Vinyl blade-edge gaskets for each louver blade.
b. Stainless-steel jamb seals or vinyl blade-end gaskets.

6. Louver Performance Ratings:

a. Free Area: As directed Not less than 6.5 sq. ft. (0.60 sq. m), 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m) or 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.

b. Point of Beginning Water Penetration: As directed Not less than 500 fpm (2.5 m/s), 600 fpm (3.0 m/s), 700 fpm (3.6 m/s), 800 fpm (4.1 m/s), 900 fpm (4.6 m/s) or 1000 fpm (5.1 m/s).
c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 500-fpm (2.5-m/s), 600-fpm (3.0-m/s), 700-fpm (3.6-m/s), 800-fpm (4.1-m/s) or 900-fpm (4.6-m/s) free-area exhaust or intake velocity.
d. Air Leakage: Not more than 3.5 cfm/sq. ft. (17.8 L/s per sq. m) of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with operable louver blades closed.

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Dual-Blade Operable Louver: Fixed drainable blades and operable plain blades combined in single frame.
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm), overall.
2. Fixed Drainable-Blade Angle: As directed 30, 35, 37.5 or 45 degrees.
3. Frame and Blade Material and Nominal Thickness: As directed Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades, 0.052 inch (1.32 mm) or 0.064 inch (1.63 mm).
4. Frame and Blade Material and Nominal Thickness: As directed Stainless-steel sheet, not less than 0.050 inch (1.27 mm) or 0.062 inch (1.59 mm).
5. Louver Performance Ratings:

a. Free Area: Not less than As directed for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
b. Point of Beginning Water Penetration: Not less than As directed.
c. Air Performance: Not more than As directed static pressure drop at As directed free-area exhaust or intake velocity.
d. Air Leakage: Not more than 1.5 cfm/sq. ft. (7.6 L/s per sq. m) of louver gross area at a differential static pressure of 0.15-inch wg (37 Pa) with operable louver blades closed.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver or louvers indicated.

1. Screen Location: Interior or Exterior face unless otherwise indicated.
2. Screening Type: As directed Bird screening, Bird screening, except where insect screening is indicated or Insect screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

2. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
3. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.
4. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.
5. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

D. Louver Screening for Galvanized-Steel Louvers:

1. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire.
2. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
3. Insect Screening: Galvanized steel, 18-by-14 (1.4-by-1.8-mm) mesh, 0.011-inch (0.28-mm) wire.
4. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

E. Louver Screening for Stainless-Steel Louvers:

1. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
2. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: As directed ASTM A653/A653M, G60 (Z180) or G90 (Z275) zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: As directed ASTM A240/A240M, Type 304, No. 2B finish, No. 2D finish, No. 4 finish, with grain running parallel to length of blades and frame members, No. 4 finish, with grain running perpendicular to length of blades and frame members, No. 4 finish, with grain running perpendicular to length of blades and parallel to length of frame members or No. 6 finish.

E. Fasteners: Use types and sizes to suit unit installation conditions.

1. As directed Use Phillips flat-head, hex-head or Phillips pan-head or tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.

5. For color-finished louvers, use fasteners with heads that match color of louvers.

F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. As directed Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As directed Champagne, Light bronze, Medium bronze, Dark bronze or Black.

C. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: As directed Three or Four coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.8 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.9 STAINLESS-STEEL SHEET FINISHES

A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Test operable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089116

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fixed extruded-aluminum and formed-metal louvers.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Sustainable Design Submittals:
1. As directed.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

D. Samples: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.5 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Warranty Period: As directed Five, 10 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
2. Wind Loads: As directed Determine loads based on a uniform pressure of 20 lbf/sq. ft. (957 Pa) or 30 lbf/sq. ft. (1436 Pa), acting inward or outward.
3. Wind Loads: Determine loads based on pressures indicated below:

a. Corner Zone: As directed Within a certain distance of building corners, uniform pressure, acting inward, and acting outward.
b. Other Than Corner Zone: Uniform pressure As directed, acting inward, and acting outward.

C. Seismic Performance: As indicated on drawings.

D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Design earthquake spectral response acceleration, short period (Sds) for Project As directed.
2. Component Importance Factor: As directed 1.5 or 1.0.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Nondrainable-Blade Louver:
1. Louver Depth: As directed 2 inches (50 mm), 4 inches (100 mm) or 6 inches (150 mm).
2. Blade Profile: As directed Plain blade without or Blade with center baffle.

3. Frame and Blade Nominal Thickness: Not less than As directed 0.080 inch (2.03 mm) or 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
4. Mullion Type: As directed Exposed, Semirecessed or Fully recessed.
5. Louver Performance Ratings:

    a. Free Area: As directed Not less than 7.5 sq. ft. (0.70 sq. m), 8.0 sq. ft. (0.74 sq. m) or 8.5 sq. ft. (0.79 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: As directed Not less than 700 fpm (3.6 m/s), 750 fpm (3.8 m/s), 800 fpm (4.1 m/s), 850 fpm (4.3 m/s), 900 fpm (4.6 m/s) or 950 fpm (4.8 m/s).
    c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 650-fpm (3.3-m/s), 700-fpm (3.6-m/s) or 750-fpm (3.8-m/s) free-area exhaust or intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal Drainable-Blade Louver:
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm).
2. Frame and Blade Nominal Thickness: As directed Not less than 0.080 inch (2.03 mm) or 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
3. Mullion Type: Exposed.
4. Louver Performance Ratings:

    a. Free Area: As directed Not less than 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m), 8.0 sq. ft. (0.74 sq. m) or 8.5 sq. ft. (0.79 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: As directed Not less than 900 fpm (4.6 m/s), 950 fpm (4.8 m/s), 1000 fpm (5.1 m/s), 1050 fpm (5.3 m/s) or 1100 fpm (5.6 m/s).
    c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 700-fpm (3.6-m/s), 750-fpm (3.8-m/s), 800-fpm (4.1-m/s) or 850-fpm (4.3-m/s) free-area exhaust or intake velocity.
    d. Air Performance: As directed Not more than 0.15-inch wg (37-Pa) static pressure drop at 900-fpm (4.6-m/s), 950-fpm (4.8-m/s) or 1000-fpm (5.1-m/s) free-area exhaust or intake velocity.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Horizontal, Continuous-Line, Drainable-Blade Louver: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only.
1. Louver Depth: 6 inches (150 mm).
2. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
3. Mullion Type: Semirecessed.
4. Louver Performance Ratings:

    a. Free Area: Not less than 7.8 sq. ft. (0.72 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: Not less than 850 fpm (4.3 m/s).

c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 800-fpm (4.1-m/s) free-area exhaust or intake velocity.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

D. Horizontal, Wind-Driven-Rain-Resistant Louver:
1. Louver Depth: As directed 4 inches (100 mm), 5 inches (125 mm), 7 inches (175 mm), 8 inches (200 mm) or 9 inches (225 mm).
2. Frame and Blade Nominal Thickness: As directed Not less than 0.080 inch (2.03 mm) or 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
3. Louver Performance Ratings:

a. Free Area: As directed Not less than 5.0 sq. ft. (0.46 sq. m), 6.0 sq. ft. (0.56 sq. m) or 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
b. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 600-fpm (3.0-m/s), 700-fpm (3.6-m/s) or 800-fpm (4.1-m/s) free-area exhaust or intake velocity.
c. Wind-Driven Rain Performance: As directed Not less than 99, 95 or 80 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s) or 8 inches (200 mm) per hour and a wind speed of 50 mph (22.4 m/s) at a core-area intake velocity of 300 fpm (1.5 m/s), 400 fpm (2.0 m/s) or 500 fpm (2.5 m/s).

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

E. Vertical, Wind-Driven-Rain-Resistant Louver:
1. Louver Depth: As directed 4 inches (100 mm), 6 inches (150 mm), 8 inches (200 mm), 9 inches (225 mm) or 12 inches (300 mm).
2. Frame and Blade Nominal Thickness: As directed Not less than 0.080 inch (2.03 mm) or 0.060 inch (1.52 mm) for blades and 0.080 inch (2.03 mm) for frames.
3. Louver Performance Ratings:

a. Free Area: As directed Not less than 5.0 sq. ft. (0.46 sq. m), 6.0 sq. ft. (0.56 sq. m) or 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
b. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 600-fpm (3.0-m/s), 700-fpm (3.6-m/s) or 800-fpm (4.1-m/s) free-area exhaust or intake velocity.
c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s), 8 inches (200 mm) per hour and a wind speed of 50 mph (22.4 m/s) at a core-area intake velocity of 300 fpm (1.5 m/s), 400 fpm (2.0 m/s) or 500 fpm (2.5 m/s) As directed.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 FIXED FORMED-METAL LOUVERS

A. Horizontal Nondrainable-Blade Louver:

1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm).
2. Blade Profile: As directed Plain blade without or Blade with center baffle.
3. Frame and Blade Material and Nominal Thickness: As directed Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades, 0.052 inch (1.32 mm) or 0.064 inch (1.63 mm).
4. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than 0.050 inch (1.27 mm) or 0.062 inch (1.59 mm).
5. Mullion Type: As directed Exposed, Semirecessed or Fully recessed.
6. Louver Performance Ratings:

    a. Free Area: As directed Not less than 6.5 sq. ft. (0.60 sq. m), 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m) or 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: As directed Not less than 550 fpm (2.8 m/s), 600 fpm (3.0 m/s), 650 fpm (3.3 m/s) or 700 fpm (3.6 m/s).
    c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 550-fpm (2.8-m/s), 600-fpm (3.0-m/s), 650-fpm (3.3-m/s) or 700-fpm (3.6-m/s) free-area exhaust or intake velocity.

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal Drainable-Blade Louver:
1. Louver Depth: As directed 4 inches (100 mm) or 6 inches (150 mm).
2. Frame and Blade Material and Nominal Thickness: As directed Galvanized-steel sheet, not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades, 0.052 inch (1.32 mm) or 0.064 inch (1.63 mm).
3. Frame and Blade Material and Nominal Thickness: As directed Stainless-steel sheet, not less than 0.050 inch (1.27 mm) or 0.062 inch (1.59 mm).
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

    a. Free Area: As directed Not less than 7.0 sq. ft. (0.65 sq. m), 7.5 sq. ft. (0.70 sq. m), 8.0 sq. ft. (0.74 sq. m) or 8.5 sq. ft. (0.79 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
    b. Point of Beginning Water Penetration: As directed Not less than 800 fpm (4.1 m/s), 850 fpm (4.3 m/s), 900 fpm (4.6 m/s), 950 fpm (4.8 m/s) or 1000 fpm (5.1 m/s).
    c. Air Performance: As directed Not more than 0.10-inch wg (25-Pa) static pressure drop at 700-fpm (3.6-m/s), 750-fpm (3.8-m/s), 800-fpm (4.1-m/s) or 850-fpm (4.3-m/s) free-area exhaust or intake velocity.
    d. Air Performance: As directed Not more than 0.15-inch wg (37-Pa) static pressure drop at 900-fpm (4.6-m/s), 950-fpm (4.8-m/s) or 1000-fpm (5.1-m/s) free-area velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: As directed Provide screen at each exterior louver or louvers indicated.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: As directed Bird screening, Bird screening, except where insect screening is indicated or Insect screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.
2. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
3. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.
4. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.
5. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

D. Louver Screening for Galvanized-Steel Louvers:

1. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire.
2. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
3. Insect Screening: Galvanized steel, 18-by-14 (1.4-by-1.8-mm) mesh, 0.011-inch (0.28-mm) wire.
4. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

E. Louver Screening for Stainless-Steel Louvers:

1. Bird Screening: Stainless steel, 1/2-inch- (13-mm-) square mesh, 0.047-inch (1.19-mm) wire.
2. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: As directed ASTM A653/A653M, G60 (Z180) or G90 (Z275) zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: As directed ASTM A240/A240M, Type 304, No. 2B finish, No. 2D finish, No. 4 finish, with grain running parallel to length of blades and frame members, No. 4 finish, with grain running perpendicular to length of blades and frame members, No. 4 finish,

with grain running perpendicular to length of blades and parallel to length of frame members or No. 6 finish.

E. Fasteners: Use types and sizes to suit unit installation conditions.

F. First option in first subparagraph below specifies flush heads; second option specifies raised heads.

1. As directed Use Phillips flat-head, hex-head or Phillips pan-head or tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

G. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As directed Champagne, Light bronze, Medium bronze, Dark bronze or Black.

C. High-Performance Organic Finish: As directed Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

D. High-Performance Organic Finish: As directed Three or Four-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 or 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.8 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent, so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A780/A780M.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.9 STAINLESS-STEEL SHEET FINISHES

A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089119

SECTION 089516 - WALL VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall vents.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. As directed.

C. Samples: For each type of metal finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Research reports.

B. Sample warranties.

1.4 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

   1. Warranty Period: As directed Five, 10, 15 or 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WALL VENTS (BRICK VENTS)

A. Extruded-Aluminum Wall Vents:
   1. Extruded-aluminum louvers and frames, not less than 0.125-inch (3.18-mm) nominal thickness, assembled by welding; with 18-by-14- (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face.
   2. Dampers: Aluminum blades and frames mounted on inside of wall vents.
   3. Finish: Mill.

B. Cast-Aluminum Wall Vents:

1. One-piece, cast-aluminum louvers and frames; with 18-by-14- (1.4-by-1.8-mm-) mesh, aluminum insect screening on inside face.
2. Dampers: Aluminum blades and frames mounted on inside of wall vents.
3. Finish: Mill.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B26/B26M, Alloy 319.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Protect unpainted surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

B. Build vents into masonry work as construction progresses; comply with requirements in Section 042000 "Unit Masonry."

END OF SECTION 089516

SECTION 090190.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes maintenance repainting as follows:

1. Removing existing paint.
2. Patching substrates.
3. Repainting, including staining and varnishing of wood.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
2. Section 040110 "Masonry Cleaning" for cleaning and removing paint from masonry.
3. Section 050170.51 "Decorative Metal Cleaning" for cleaning and removing paint from decorative metal.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each type of paint system and each pattern, color, and gloss.

1. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
2. Label each Sample for location and application.

D. Product List: Printout of current "MPI Approved Products List" for each MPI-product category specified in paint systems, with the proposed product highlighted.

1.5 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer-matched colors.

1.6 QUALITY ASSURANCE

A. Color Matching: Custom computer-match paint colors to colors indicated in maintenance repainting schedule(s) at the end of Part 3 or on Drawings. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.

B. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

1. Surface-preparation mockups using applicable specified methods of cleaning and other surface preparation.
2. Coating mockups to represent surfaces and conditions for application of each type of coating system.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

2.3 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As indicated with each paint system in maintenance repainting schedule(s) at the end of Part 3, Match Architect's samples or As selected by Architect from full range of industry colors.

2.4 PAINT MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.5 PAINT MATERIAL MANUFACTURERS

2.6 PAINT MATERIALS

A. Primers and Sealers:

1. Primer Sealer, Latex, Interior: MPI #50.
    a. Basis-of-Design Product: As directed.
2. Primer, Latex, for Interior Wood: MPI #39.
    a. Basis-of-Design Product: As directed
3. Primer Sealer, Alkyd, Interior: MPI #45.
    a. Basis-of-Design Product: As directed.
4. Undercoat, Enamel, Interior: MPI #46.
    a. Basis-of-Design Product: As directed.
5. Primer, Stain Blocking, Water Based: MPI #137.
    a. Basis-of-Design Product: As directed.
6. Alkyd, Sanding Sealer, Clear: MPI #102.
    a. Basis-of-Design Product: As directed.
7. Shellac: MPI #88.
    a. Basis-of-Design Product: As directed.
8. Stain, Semi-Transparent, for Interior Wood: MPI #90.
    a. Basis-of-Design Product: As directed.

B. Metal Primers:

1. Primer, Metal, Surface Tolerant: MPI #23.
    a. Basis-of-Design Product: As directed.
2. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.
    a. Basis-of-Design Product: As directed.
3. Primer, Rust-Inhibitive, Water Based: MPI #107.
    a. Basis-of-Design Product: As directed.

C. Wood Primers:

1. Primer, Latex for Exterior Wood: MPI #6.

a. Basis-of-Design Product: As directed.

2. Primer, Alkyd for Exterior Wood: MPI #5.

a. Basis-of-Design Product: As directed.

D. Water-Based Paints:

1. Latex, Exterior Flat (Gloss Level 1): MPI #10.

a. Basis-of-Design Product: As directed.

2. Latex, Exterior Low Sheen (Gloss Levels 3-4): MPI #15.

a. Basis-of-Design Product: As directed.

3. Latex, Exterior Semigloss (Gloss Level 5): MPI #11.

a. Basis-of-Design Product: As directed.

4. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.

a. Basis-of-Design Product: As directed.

5. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

a. Basis-of-Design Product: As directed.

6. Latex, Interior, (Gloss Level 2): MPI #44.

a. Basis-of-Design Product: As directed.

7. Latex, Interior, (Gloss Level 3): MPI #52.

a. Basis-of-Design Product: As directed.

8. Latex, Interior, (Gloss Level 4): MPI #43.

a. Basis-of-Design Product: As directed.

9. Latex, Interior, Semigloss, (Gloss Level 5): MPI #54.

a. Basis-of-Design Product: As directed.

10. Latex, Interior, Gloss, (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.

a. Basis-of-Design Product: As directed.

11. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

    a. Basis-of-Design Product: As directed.

12. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 2): MPI #144.

    a. Basis-of-Design Product: As directed.

13. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 3): MPI #145.

    a. Basis-of-Design Product: As directed.

14. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 4): MPI #146.

    a. Basis-of-Design Product: As directed.

15. Latex, Interior, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.

    a. Basis-of-Design Product: As directed.

16. Latex, Interior, Institutional Low Odor/VOC, Gloss (Gloss Level 6): MPI #148.

    a. Basis-of-Design Product: As directed.

E. Solvent-Based Paints:

1. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.

    a. Basis-of-Design Product: As directed.

2. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.

    a. Basis-of-Design Product: As directed.

3. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.

    a. Basis-of-Design Product: As directed.

4. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.

    a. Basis-of-Design Product: As directed.

5. Alkyd, Interior, (Gloss Level 3): MPI #51.

    a. Basis-of-Design Product: As directed.

6. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.

    a. Basis-of-Design Product: As directed.

7. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.

a. Basis-of-Design Product: As directed.

F. Floor Coatings:

1. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.

a. Basis-of-Design Product: As directed.

2. Floor Paint, Latex, Gloss MPI #68.

a. Basis-of-Design Product: As directed.

3. Floor Paint, Alkyd, Low Gloss (Gloss Level 6): MPI #59.

a. Basis-of-Design Product: As directed.

4. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.

a. Basis-of-Design Product: As directed.

G. Solvent-Based Varnishes:

1. Varnish, with UV Inhibitor, Exterior, Semigloss (Gloss Level 5): MPI #30.

a. Basis-of-Design Product: As directed.

2. Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6): MPI #29.

a. Basis-of-Design Product: As directed.

3. Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7): MPI #28.

a. Basis-of-Design Product: As directed.

4. Varnish, Interior, Flat (Gloss Level 1): MPI #73.

a. Basis-of-Design Product: As directed.

5. Varnish, Interior, Semigloss (Gloss Level 5): MPI #74.

a. Basis-of-Design Product: As directed.

6. Varnish, Interior, Gloss (Gloss Level 6): MPI #75.

a. Basis-of-Design Product: As directed.

H. Polyurethane Varnishes:

1. Varnish, Interior, Polyurethane, Oil-Modified, Gloss (Gloss Level 6): MPI #56.

a. Basis-of-Design Product: As directed.

2. Varnish, Polyurethane, Moisture-Cured, Gloss (Gloss Level 6): MPI #31.

    a. Basis-of-Design Product: As directed.

2.7 PATCHING MATERIALS

A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated from weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

B. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.

C. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

D. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MAINTENANCE REPAINTING, GENERAL

A. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for repainting.
3. Allow other trades to repair items in place before repainting.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.

C. Heat Processes: Do not use torches, heat guns, or heat plates.

3.2 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.

B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.
3. Gypsum Plaster: 12 percent.
4. Masonry (Clay and CMU): 12 percent.
5. Portland Cement Plaster: 12 percent.
6. Wood: 15 percent.

C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.3 PREPARATORY CLEANING

A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

E. Chemical Rust Removal:

1. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.4 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.

   a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
   b. Wood Substrates: Do not use wire brushes.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

   a. Equip units with pressure gages.
   b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
   c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
   d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
   e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

C. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. As directed rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

D. Paint Removal with Low-Odor, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. As directed Rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

3.5 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Wood Substrate:

1. As directed repair wood defects including dents and gouges more than 1/8 inch (3 mm) or 1/4 inch (6 mm) in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.

C. Cementitious Material Substrate:

1. General: As directed repair defects including dents and chips more than 1/4 inch (6 mm) or 1/2 inch (13 mm) in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.

D. Gypsum-Plaster and Gypsum-Board Substrates:

1. As directed repair defects including dents and chips more than 1/8 inch (3 mm) or 1/4 inch (6 mm) in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

E. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
2. Defects in Metal Surfaces: As directed repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.6 PAINT APPLICATION, GENERAL

A. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

B. Apply a transition coat over incompatible existing coatings.

C. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.

D. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

3.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 SURFACE-PREPARATION SCHEDULE

A. General: Before painting, prepare surfaces where indicated on Drawings for painting according to applicable requirements specified in this schedule.

1. Examine surfaces to evaluate each surface condition according to paragraphs below.
2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
3. Repair substrate defects according to "Substrate Repair" Article.

B. Surface Preparation for MPI DSD 0 Degree of Surface Degradation:

1. Surface Condition: Existing paint film in good condition and tightly adhered.
2. Paint Removal: Not required.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.

C. Surface Preparation for MPI DSD 1 Degree of Surface Degradation:

1. Surface Condition: Paint film cracked or broken but adhered.
2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.

D. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.
2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

E. Surface Preparation for MPI DSD 3 Degree of Surface Degradation:

1. Surface Condition: As directed Paint film severely deteriorated, obscuring fine architectural detail work because of paint-layer buildup and surface indicated to have paint completely removed.
2. Paint Removal: Completely remove paint film by hand-tool or chemical paint-removal methods. Remove rust.
3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

F. Surface Preparation for MPI DSD 4 Degree of Surface Degradation:

1. Surface Condition: Missing material, small holes and openings, and deteriorated or corroded substrate.
2. Substrate Preparation: Repair, replace, and treat substrate according to "Substrate Repair" Article and requirements in other Specification Sections.

3. Preparation for Painting: Sand substrate surfaces to smooth remaining paint film edges and prepare according to paint manufacturer's written instructions for substrate construction materials. Remove rust.
4. Painting: Paint as required for MPI DSD 2 degree of surface degradation.

3.10 EXTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Ferrous Metal Substrates: Iron railing and gate:

1. Alkyd System: MPI REX 5.1D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
d. Intermediate Coat: Alkyd, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior, semigloss (Gloss Level 5), MPI #94.
f. Topcoat: Alkyd, exterior, gloss (Gloss Level 6), MPI #9.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

B. Wood Columns, Beams, Ceilings, Siding and Fencing as directed:

1. Latex System: MPI REX 6.2A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex for Exterior Wood, MPI #6.
d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex for Exterior Wood, MPI #6.
f. Intermediate Coat: Latex, exterior, matching topcoat.
g. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
h. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
i. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
j. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.2C system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.

d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

C. Wood Doors, Windows, Frames, Casings and Smooth Fasciae as directed:

1. Latex System: MPI REX 6.3A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
f. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
g. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
h. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
i. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.3B system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Alkyd, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399,existing colors or colors indicated on Drawings.

3. Varnish System (Clear): MPI REX 6.3F.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
d. Intermediate Coat: Exterior varnish matching topcoat.
e. Topcoat: Varnish, with UV inhibitor, exterior, semigloss (Gloss Level 5), MPI #30.
f. Topcoat: Varnish, with UV inhibitor, exterior, gloss (Gloss Level 6), MPI #29.
g. Topcoat: Varnish, marine spar, exterior, gloss (Gloss Level 6), MPI #28.

D. Wood Deck and Stairs:

1. Latex Porch and Floor System over Alkyd Primer: MPI REX 6.5A system over a transition coat.

   a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
   b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd/Oil for Exterior Wood, MPI #5.
   c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd/Oil for Exterior Wood, MPI #5.
   d. Intermediate Coat: Floor Paint, Latex, matching topcoat.
   e. Topcoat: Floor paint, latex, low gloss, MPI #60.
   f. Topcoat: Floor paint, latex, gloss, MPI #68.
   g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
   h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Alkyd Floor Enamel System: MPI REX 6.5B system over a transition coat.

   a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
   b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
   c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
   d. Intermediate Coat: Floor enamel matching topcoat.
   e. Topcoat: Floor paint, alkyd, low gloss, MPI #59.
   f. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
   g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
   h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

E. Wood Shingle or Shake Siding as directed:

1. Latex System: MPI REX 6.6A system over a transition coat.

   a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
   b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
   c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
   d. Intermediate Coat: Latex, exterior, matching topcoat.
   e. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
   f. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
   g. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
   h. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
   i. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.6B system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

3.11 INTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Ferrous Metal Substrates: Iron railing:

1. Latex System: MPI RIN 5.1N system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
d. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Rust-Inhibitive, Water Based, MPI #107.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
f. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
g. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Rust-Inhibitive, Water Based, MPI #107.
h. Intermediate Coat: Latex matching topcoat.
i. Topcoat: Latex, interior, flat (Gloss Level 1), MPI #53.
j. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
k. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
l. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
m. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
n. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
o. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Alkyd System: MPI RIN 5.1E system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.

d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
f. Intermediate Coat: Alkyd, matching topcoat.
g. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
h. Topcoat: Alkyd, interior (Gloss Level 3), MPI #51.
i. Topcoat: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.
j. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

B. Wood Columns, Beams and Ceilings as directed:

1. Latex System over Latex Primer: MPI RIN 6.2D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Latex System over Alkyd Primer: MPI RIN 6.2A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Undercoat, Enamel, Interior, MPI #46.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior, MPI #46.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

C. Wood Doors, Windows, Frames and Moldings:

1. Latex System over Latex Primer: MPI RIN 6.3U system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
f. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Low-Odor Latex System over Latex Primer: MPI RIN 6.3V system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
f. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
i. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
j. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

3. Alkyd Varnish System (Clear): MPI RIN 6.3J.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Shellac, MPI #88.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Alkyd, Sanding Sealer, Clear, MPI #102.
d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Shellac, MPI #88.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Alkyd, Sanding Sealer, Clear, MPI #102.
f. Intermediate Coat: Interior varnish matching topcoat.
g. Topcoat: Varnish, interior, flat (Gloss Level 1), MPI #73.
h. Topcoat: Varnish, interior, semigloss (Gloss Level 5), MPI #74.
i. Topcoat: Varnish, interior, gloss (Gloss Level 6), MPI #75.

D. Wood Paneling, Casework and Millwork as directed:

1. Latex System over Latex Primer: MPI RIN 6.4T system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
f. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Low-Odor Latex System over Latex Primer: MPI RIN 6.4D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
f. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
i. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
j. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

3. Latex System over Alkyd Primer: MPI RIN 6.4A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Undercoat, Enamel, Interior, MPI #46.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior, MPI #46.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

E. Wood Floors and Stairs:

1. Alkyd Floor Enamel System: MPI RIN 6.5A system over a transition coat.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
    c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
    d. Intermediate Coat: Floor enamel matching topcoat.
    e. Topcoat: Floor paint, alkyd, low gloss, MPI #59.
    f. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
    g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
    h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Polyurethane Varnish System (Clear): MPI RIN 6.5C.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
    c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
    d. Intermediate Coat: Interior varnish matching topcoat.
    e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss, MPI #56.

3. Moisture-Cured Polyurethane System (over Stain): MPI RIN 6.5L.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Stain, Semi-Transparent, for Interior Wood, MPI #90.
    c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Stain, Semi-Transparent, for Interior Wood, MPI #90.
    d. Intermediate Coat: Moisture-cured polyurethane varnish matching topcoat.
    e. Topcoat: Varnish, polyurethane, moisture cured, gloss (Gloss Level 6), MPI #31.
    f. Stain Color: Match adjacent, cleaned wood of same type, existing color or color indicated on Drawings.

F. Plaster:

1. Low-Odor Latex System over Waterborne Primer: MPI RIN 9.2M system over a transition coat.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer Sealer, Latex, Interior, MPI #50.
    c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based, MPI #137.
    d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior, MPI #50.

e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based, MPI #137.
f. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
i. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
j. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
k. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
l. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

2. Latex System over Alkyd Primer: MPI RIN 9.2K system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer Sealer, Alkyd, Interior, MPI #45.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat Primer Sealer, Alkyd, Interior, MPI #45.
d. Intermediate Coat: Latex matching topcoat.
e. Topcoat: Latex, interior, flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, existing colors or colors indicated on Drawings.

END OF SECTION 090190.52

SECTION 090320 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Repair and replacement of historic interior and exterior lime plaster.
2. Repair and replacement of interior gypsum plaster.
3. Replication of cast plasterwork in gypsum plaster.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090391 "Historic Treatment of Plain Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of plaster.
2. Review methods and procedures related to historic treatment of plaster and fire protection.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Cast-Plaster Manufacturer Qualifications: A firm regularly engaged in manufacturing custom-cast plasterwork for building restoration purposes, of same types and of similar size, complexity, and tolerances as those required for the Work.

C. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

a. Install 6 linear ft. (2 m) of wet-applied plaster molding.
b. Install 6 linear ft. (2 m) of cast-plaster molding, but not less than two cast units.
c. Repair 3 linear ft. (1 m) of plaster cracks.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

A. Hydrated Lime: ASTM C206, Type S or Type N.

B. Lime Putty: Slaked hydrated lime or factory-prepared lime putty according to ASTM C1489.

C. Sand Aggregates: ASTM C897.

1. Finish-Coat Sand: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Pigments for Colored Plaster: ASTM C979/C979M and having a record of satisfactory performance in lime plaster.

E. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of cattle, goat, or hog hair or body hair from horses, natural linen, cotton, hemp, or jute fiber or alkali-resistant glass or polypropylene fiber as directed; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

2.2 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C28/C28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C28/C28M.
4. High-Strength Gypsum Neat Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.

5. Gypsum Gaging Plaster. ASTM C28/C28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C28/C28M; manufacturer's standard, mill-mixed, gaged, interior finish.
8. Gypsum Keene's Cement: ASTM C61/C61M.

B. Hydrated Lime: ASTM C206, Type S or Type N.

C. Aggregates:

1. Aggregate for Base-Coat Plasters: ASTM C35, sand or perlite as directed.
2. Aggregate for Float Finishes: ASTM C35, sand or perlite; graded per ASTM C842 as directed.

D. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of cattle, goat, or hog hair or body hair from horses, natural linen, cotton, hemp, or jute fiber or glass or polypropylene fiber as directed; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

E. Fabric Reinforcing: Coarse, open-weave, sackcloth made of natural linen, cotton, hemp, or jute; free of grease and oils or Coarse, open-weave, alkali-resistant fiberglass or polypropylene fabric as directed; free of grease, waxes, and oils.

F. Bonding Compound: ASTM C631.

2.3 LATH

A. Wood Lath: 1/4 inch by 1-1/4 inch (6 mm by 32 mm) sound, straight-grained, wood strips.

B. Metal Lath:

1. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet, ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coated.

a. Paper Backing: Kraft paper factory bonded to back of lath.
b. Diamond-Mesh Lath: Flat or Self-furring, 2.5 lb/sq. yd. (1.4 kg/sq. m) or 3.4 lb/sq. yd. (1.8 kg/sq. m) as directed.
c. Flat Rib Lath: Rib depth of not more than 1/8 inch (3 mm), 2.75 lb/sq. yd. (1.5 kg/sq. m) or 3.4 lb/sq. yd. (1.8 kg/sq. m) as directed.
d. 3/8-Inch (9.5-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m) or 4 lb/sq. yd. (2.2 kg/sq. m) as directed.

2.4 TRIM ACCESSORIES

A. General: According to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
2. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

    a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
    b. Small nose cornerbead with perforated flanges; use on curved corners.
    c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
    d. Bull nose cornerbead, radius of 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.

4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Lime Plaster: ASTM C1063.
2. For Gypsum Plaster: ASTM C841.
3. For Wood Lath: ASTM C841 requirements for wood-floor-runner or wood-furring fasteners unless otherwise indicated on Drawings.

C. Wire Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

2.6 CAST-PLASTER FABRICATIONS

A. General: Fabricate cast-plaster units with uniformly finished surfaces and sharply defined details; repair hollows, voids, scratches, and other surface imperfections.

1. Fabricate units of sizes and shapes to match similar existing plasterwork unless otherwise indicated.
2. Configure joints between units so that they may be finished flush or otherwise concealed inconspicuously.
3. Maximum deviation from true line, size, or shape shall be 1/16 inch (2 mm), noncumulative.

B. Composition: Fabricate units from gypsum-plaster materials. Reinforce units with fiber or fabric reinforcing.

1. Plaster Face: Molding plaster with or without aggregate as is standard with manufacturer for required surface finish.
2. Plaster Backup: Molding plaster with or without aggregate, but with high-proportion of plaster-saturated fiber or fabric reinforcing as is standard with manufacturer.

C. Thickness: Not less than 3/16-inch (5-mm) thickness of plaster material at any point.

D. Finish: Smooth for paint finish.

E. Embedments: Incorporate manufacturer's standard embedments for attaching units to supporting elements unless otherwise indicated. Cover embedments with not less than 3/16-inch (5-mm) thickness of reinforced plaster material.

F. Joint-Treatment Materials: As recommended in writing by manufacturer.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify that substrate surface conditions are suitable for repairs.
3. Provide lath, furring, and support systems for plaster included in the work of this Section.
4. Replace lost details in new, wet-applied and cast plaster that replicate existing or indicated plaster configurations.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

E. As directed Wet wood lath, masonry and concrete bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.3 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings.

B. Lime-Plaster Base Coats:

1. Scratch Coat: As directed 1 part lime putty, 2-1/2 parts base-coat sand or 1 part lime putty, 2-1/2 parts base-coat sand, and fiber. Add hair fiber to mix and evenly distribute it without clumps just before spreading.
2. Brown Coat: 1 part lime putty, 3 parts base-coat sand.

C. Lime-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finish: As required to match finish of design reference sample or 3 parts lime putty, 1 part finish-coat sand as directed.
2. Finish-Coat Mix for Smooth-Float Finish: As required to match finish of design reference sample or 1 part lime putty, 1 part finish-coat sand as directed.
3. Finish-Coat Mix for Sandy Float Finish: As required to match finish of design reference sample or 1 part lime putty, 3 parts finish-coat sand as directed.

D. Lime-Plaster Finishes: Match finish(es) of design reference sample(s).

1. Provide smooth-troweled finish unless otherwise indicated or where indicated. As directed apply in one layer, two layers or three layers totaling 1/16 inch (2 mm), 1/8 inch (3 mm) or 3/16 inch (5 mm) thick.
2. Provide smooth-float finish unless otherwise indicated or where indicated. As directed apply in one layer, two layers or three layers totaling 1/16 inch (2 mm), 1/8 inch (3 mm) or 3/16 inch (5 mm) thick.
3. Provide sandy-float finish unless otherwise indicated or where indicated. As directed apply in one layer, two layers or three layers totaling 1/16 inch (2 mm), 1/8 inch (3 mm) or 3/16 inch (5 mm) thick.

E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.

3.4 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C842 unless otherwise indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Gypsum-Plaster Base Coats:

1. Base Coats over Wood Lath: Gypsum neat plaster with job-mixed sand and fiber, wood-fibered plaster with job-mixed sand or lightweight ready-mixed plaster with fiber as directed.
2. Base Coats over Expanded-Metal Lath: As directed High-strength gypsum, Gypsum neat plaster with job-mixed sand for scratch and brown coats. Add fiber to scratch coat.
3. Base Coats over Expanded-Metal Lath:

    a. Scratch Coat: Gypsum wood-fibered plaster; neat or with job-mixed sand.
    b. Brown Coat: As directed Gypsum wood-fibered plaster with job-mixed sand, neat plaster with job-mixed sand, lightweight ready-mixed plaster or neat plaster with job-mixed perlite.

4. Base Coats over Unit Masonry: As directed Gypsum wood-fibered plaster with job-mixed sand, neat plaster with job-mixed sand or lightweight ready-mixed plaster.
5. Base-Coat Mix over Monolithic Concrete: Gypsum neat plaster with job-mixed sand.

D. Gypsum-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finishes: As directed Gypsum gaging plaster, Gypsum ready-mixed finish plaster, High-strength gypsum gaging plaster or Gypsum Keene's cement.
2. Finish-Coat Mix for Float Finishes: As directed Gypsum gaging plaster or Gypsum Keene's cement.
3. Finish-Coat Mix for Textured Finishes: Gypsum ready-mixed finish plaster.

E. Gypsum-Plaster Finishes: Match finish(es) of design reference sample(s).

1. Provide troweled finish unless otherwise indicated or where indicated.
2. Provide float finish unless otherwise indicated or where indicated.
3. Provide textured finish where indicated.

3.5 CAST-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle and replace cast-plaster that is damaged or deteriorated at locations indicated on Drawings. Carefully dismantle whole cast units from joint to joint, without damaging surrounding plasterwork.

B. Replacement Material: Replace cast fabrications with cast gypsum-plaster fabrications.

C. Adhering Cast Plaster: Wet the substrate in replacement area and affix cast plaster using finish-coat plaster for smooth-troweled finish as adhesive. Support units until adhesive can fully support weight of plaster. Remove excess adhesive.

D. Install cast-plaster fabrications level, plumb, true, and aligned with adjacent materials and ready to receive required finishes. Use concealed shims secured with wet plaster where required for alignment.

E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair as directed by Architect.

3.6 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster.

B. Wood Lath: Install wood lath in same orientation and spacing as remaining wood lath and with lath ends supported by furring or framing. Stagger ends of adjacent laths over different supports, not aligned, and secure with fasteners at each end and spaced a maximum of 24 inches (610 mm) o.c. into supports.

C. Metal Lath: Install according to ASTM C1063 for lime plaster and ASTM C841 for gypsum plaster.

3.7 PATCH-TYPE REPAIR

A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks at locations indicated on Drawings.

1. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
2. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
3. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
4. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material.
5. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.

B. Lime-Plaster Mix: As directed 3 parts lime putty, 1 part gypsum neat plaster or gypsum gaging plaster, 1 part lime putty, 3 parts sand, 1 part lime putty, 2-1/2 parts sand, applied in two coats with fiber in first coat or Repair mix demonstrated in mockup. Add hair fiber to mix and evenly distribute it without clumps just before spreading.

C. Gypsum-Plaster Mix: As directed Gypsum gaging plaster, Gypsum neat plaster with job-mixed sand, Gypsum neat plaster with job-mixed sand, applied in two coats with fiber in first coat or Repair mix demonstrated in mockup. Add hair fiber to mix and evenly distribute it without clumps just before spreading.

D. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

E. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.8 HAIRLINE CRACK REPAIR

A. General: Repair cracks 1/32 inch (1 mm) in width or narrower in otherwise sound plaster at locations indicated on Drawings.

B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.

C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. As directed Force finish-coat plaster without aggregate or repair material demonstrated in mockup into crack, filling crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

3.9 LARGE CRACK REPAIR

A. General: Repair cracks over 1/32 inch (1 mm) in width in otherwise sound plaster at locations indicated on Drawings.

B. Open crack to at least 1/8 inch (3 mm) in width and full depth with V-groove tool and check for bond separation or lath deterioration.

C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material.

E. Wet substrate to damp condition, but without visible water droplets.

F. As directed Install finish-coat plaster or repair material demonstrated in mockup to fill crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

END OF SECTION 090320

SECTION 090353 - HISTORIC TREATMENT OF METAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of stamped metal ceilings as follows:

1. Stabilizing and protecting metal.
2. Repairing metal and replacing damaged and missing components in place.
3. Dismantling metal for shop repair and replacement of components; reinstalling repaired metal.
4. Repairing and replacing wood materials that support the ceiling.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 057500 "Decorative Formed Metal" for new decorative formed metal construction.

1.2 DEFINITIONS

A. Cornice Depth: Measurement of how far a cornice will extend down the wall from the ceiling.

B. Cornice Projection: Measurement of how far a cornice will extend out from the wall, across the ceiling.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of metal ceilings.
2. Review methods and procedures related to historic treatment of metal ceilings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic metal ceiling repair specialist. Experience in installing and finishing new metal ceiling systems is insufficient experience for historic treatment work on metal ceilings.

B. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials, execution, fabrication, and installation. Prepare mockups so they are inconspicuous.

1. Dent Removal: Repair a ceiling and cornice panel of each type by pushing out dents from the back side or filling dents with sculpted metal-patching compound, and flattening edges to align repaired panels flush with adjacent panels.
2. Replacing Panels: Replace a missing or excessively damaged ceiling and cornice panel of each type with new or repaired, salvaged panels, and align edges of replacement panels flush with adjacent panels.

PART 2 - PRODUCTS

2.1 METAL PANELS

A. Field Panel: Factory-stamped and prefinished metal ceiling panel(s) for the main area of the ceiling. Fabricate panels that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: Aluminum, Aluminum-zinc alloy-coated steel, Copper, Tin-plated steel, Zinc or Zinc-coated (galvanized) steel as directed; of thickness needed for panel size and embossed design.
2. Size: Match existing, 24 by 24 inches (610 by 610 mm) or 24 by 48 inches (610 by 1219 mm) as directed.
3. Pattern Type: Match existing, Match Architect's samples or as selected by Architect from manufacturer's full range.

    a. Panel Assembly: Where indicated on Drawings or by manufacturer's product name or designation, form panels with matched seams that form a larger medallion or design.

4. Exposed Finish: As directed Match design reference sample, match existing, as indicated on Drawings, Bright mill finish, Antiqued, primed for on-site painting, Powder coated with clear organic coating.

a. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from full range of industry colors and color densities.

B. Filler Panel: Factory-stamped and -prefinished metal ceiling panel(s) for the ceiling perimeter between field panels and cornice. Fabricate panels that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: As directed Aluminum, Aluminum-zinc alloy-coated steel, Copper, Tin-plated steel, Zinc or Zinc-coated (galvanized) steel; of thickness needed for panel size and embossed design.
2. Panel Width: As directed Match existing, 11.5 inches (292 mm), 20 inches (508 mm) or 24 inches (610 mm).
3. Pattern Type: As directed Match existing, Match Architect's samples or as selected by Architect from manufacturer's full range.
4. Exposed Finish: As directed Match design reference sample, match existing, As indicated on Drawings, Bright mill finish, Antiqued, primed for on-site painting, Powder coated with clear organic coating.

a. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from full range of industry colors and color densities.

C. Cornice Panel: Factory-stamped and prefinished metal ceiling panel(s) for the ceiling perimeter at top of walls Fabricate panels that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: As directed Aluminum, Aluminum-zinc alloy-coated steel, Copper, Tin-plated steel, Zinc or Zinc-coated (galvanized) steel; of thickness needed for panel size and embossed design.
2. Projection and Depth: Match existing, 2.25 x 2.25 inches (57 x 57 mm), 3 x 3 inches (76 x 76 mm), 4 x 6 inches (102 x 152 mm), 6 x 8 inches (152 x 203 mm), 9 x 9 inches (229 x 229 mm) or 10 x 12 inches (254 x 305 mm).
3. Miters: Provide inside and outside preformed miters.
4. Pattern Type: Match existing, Match Architect's samples, As selected by Architect from manufacturer's full range or Combination of forms as selected by Architect from industry's full range.
5. Exposed Finish: As directed Match design reference sample, match existing, as indicated on Drawings or Bright mill finish, Antiqued, primed for on-site painting, Powder coated with clear organic coating.

a. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from full range of industry colors and color densities.

D. Molding: Factory-stamped metal molding panel(s) for the ceiling perimeter to cover continuous joint or space between edges of field and filler panels. Fabricate panels that match existing by using original, historic dies or custom-made patterns and dies.

1. Material: Aluminum, Aluminum-zinc alloy-coated steel, Copper, Tin-plated steel, Zinc or Zinc-coated (galvanized) steel; of thickness needed for panel size and embossed design.
2. Molding Width: As directed Match existing, 3.25 inches (83 mm), 4 inches (102 mm) or 7 inches (178 mm).

3. Pattern Type: Match existing, Match Architect's samples or as selected by Architect from manufacturer's full range.
4. Exposed Finish: As directed Match design reference sample, match existing, As indicated on Drawings, Bright mill finish, Antiqued, Primed for on-site painting, Powder coated with clear organic coating.

    a. Color: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from full range of industry colors and color densities.

2.2 MATERIALS

A. Provide metal ceiling materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated.

2.3 ACCESSORIES

A. Metal-Patching Compound: Two-part, epoxy- or polyester-resin metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion or deformation. Filler shall be capable of filling deep holes and spreading to feather edge.

B. Fasteners: Fasteners shall be of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.

1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting metal ceiling components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
3. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.
4. Nails for Ceiling Panels: As directed 1-inch- (25-mm-) or 1.5-inch- (38-mm-) long, cone-head or finishing nails.
5. Fasteners for Nailable Substrates: As directed 1.5-inch- (38 mm-) or 2-inch- (51 mm-) long, flat-head nails or countersunk, flat-head wood screws.

C. Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, colored to match painted ceiling panels being installed or Type C for bright metal finish.

D. Nailable Substrates:

1. Wood Furring: As directed 1-by-2-inch nominal (19-by-38-mm actual) or 1-by-3-inch nominal (19-by-63-mm actual) size and according to furring requirements as specified in Section 061000 "Rough Carpentry."
2. Plywood: 3/8-inch (9.5-mm) nominal thickness structural, fire-retardant-treated plywood sheathing panels as specified in Section 061600 "Sheathing."
3. Wood Blocking: Concealed, fire-retardant-treated wood supports as specified in Section 061000 "Rough Carpentry."

2.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Abrasive Materials:

1. Abrasive Pads: Nonscratch, of the following type(s):

   a. Abrasive Pad with Sponge: Combination plastic abrasive pad, consisting of a sponge enclosed with a woven urethane, polypropylene, or other plastic mesh or fabric, without other abrasive components that can scratch metal.
   b. Abrasive Pad of Plant Fibers: Agave, loofa, or another tough plant fiber, without other abrasive components that can scratch metal.

2. Medium Abrasives for Ferrous Metals: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

E. Wash Cloths: Lint-free, absorbent, durable cloth without abrasives that can scratch metal.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.5 PANEL FABRICATION

A. Fabricate metal ceiling items and components in sizes and profiles to match existing metal ceiling unless otherwise indicated, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit.

B. Stamped panels shall have embossed designs that are sharp and clear and shall be trimmed to exact size, so that installed edges will be concealed by proximity to the raised beads of the panel design.

2.6 ALUMINUM FINISHES

A. Mill finish.

B. Bright mill finish.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, applying, and baking finish.

2.7 FERROUS METAL FINISHES

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 090391 "Historic Treatment of Plain Painting" for finish painting of primed historic metal.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish, consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.

B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish or Architect's sample, free of cross scratches.

1. Run grain to match existing metal.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 HISTORIC METAL CEILING REPAIR, GENERAL

A. Execution of the Work: In repairing historic items, disturb remaining existing work as minimally as possible and as follows:

1. Stabilize metal ceilings to reestablish structural integrity while maintaining the existing form of each item.
2. Remove deteriorated coatings and corrosion.
3. Sequence work to minimize time before protective coatings are reapplied.
4. Repair items where stabilization is insufficient to stop progress of deterioration.
5. Repair items in place unless otherwise indicated and retain as much original material as possible.
6. Replace or reproduce historic items where indicated or scheduled.
7. Make historic treatment of materials reversible whenever possible.
8. Install temporary protective measures to stabilize metal ceilings that shall be repaired later.

B. Mechanical Coating Removal: Use gentlest mechanical methods, such as scraping and wire brushing, that do not abrade metal substrate. Do not use abrasive methods, such as sanding, or power tools except as approved by Architect.

C. Repairing Metal Ceiling Panels: Match existing materials and features, retaining as much original material as possible to complete the repair.

D. Replacing Metal Ceiling Panels: Where indicated, duplicate and replace panels with new metal, matching existing metal.

1. Replace heavily deteriorated or missing features of metal ceiling with compatible materials, using surviving prototypes to create patterns or dies for duplicate replacements.

3.2 PREPARATORY CLEANING

A. Perform preparatory cleaning before performing repair work. Use only those methods indicated for each type of metal ceiling and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

B. Water Cleaning: Clean with cold or hot water applied with sponges or wash cloths. Supplement with natural-fiber or plastic bristle brush and abrasive pads. Use small brushes to remove soil and loose paint from joints and crevices. Leave uniform patina intact.

C. Detergent Cleaning:

1. As directed Wet surface with cold or hot water applied with sponges or wash cloths.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush and abrasive pads until soil and loose paint is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil and loose paint from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Leave uniform patina intact.
3. As directed Rinse with cold or hot water applied with sponges or wash cloths to remove detergent solution, soil, and loose paint.

D. Chemical Rust Removal:

1. Remove loose rust scale with approved, medium abrasives for ferrous metals.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean wash cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

E. Mechanical Rust Removal:

1. Remove rust with approved, medium abrasives for ferrous metals.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.

3. Dry immediately with clean wash cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 PANEL DISMANTLING AND REPAIR

A. Repair metal ceiling panels in place insofar as practicable, unless otherwise indicated. Where necessary, dismantle panels from their substrate and repair and reinstall them.

B. Perform dismantling work as required in Section 024296 "Historic Removal and Dismantling."

C. Deformed Panels: Flatten bent and deformed panels, so that embossed pattern along full length of panel edges will again nest tightly against adjacent panels insofar as practicable.

D. Defects in Painted Metal Surfaces: As directed Repair defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound. Remove burrs. Prime iron and steel surfaces immediately after repair to prevent flash rusting.

E. Defects in Bare Metal Surfaces: As directed Repair defects in existing metal surfaces, including dents and gouges more than 1/16 inch (1.6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and tears by filling with metal-patching compound, colored to match the metal finish. Do not extend patching compound beyond the local area of the repair. Remove burrs.

3.4 NAILABLE SUBSTRATES

A. Repair damaged nailable substrates that are exposed by removed or missing ceiling panels. Replace nailable substrate in kind where it is lost or irreparable and where repairs are extensive.

B. Furring: Install longitudinally and transversely across the ceiling area at 24 inches (610 mm) o.c. and flush with each other unless otherwise indicated. Fasten to structural members above ceiling. Where structural members are not level, insert shims between furring strips and the structural members before fully tightening the fasteners. Install fasteners with heads flush with or slightly recessed beneath surface of furring; sand smooth and flush any projections to prevent misalignment of the metal ceiling panels.

C. Plywood: Install as specified in Section 061600 "Sheathing" unless otherwise indicated. Fasten to structural members above ceiling. Install fasteners with heads flush with or slightly recessed beneath surface of plywood; sand smooth and flush any projections to prevent misalignment of the metal ceiling panels.

D. Blocking: Install blocking to support unsupported ends and edges of nailable substrates.

3.5 PANEL INSTALLATION

A. Installation: Install ceiling panels according to new-product manufacturer's written instructions. Lap panels matching existing method of lapping panels.

1. Panel Reinstallation: Use original nail holes to reinstall repaired panels.

B. Field Panels: Overlap and nest panels' beads with each other, and nail panels to substrate, locating nails on the nailing bead. Where needed, use flat-head nails on the concealed side of beads to temporarily hold panels in position until final nailing. Lap panels to minimize joint visibility from entrance to room unless otherwise indicated. Space nails 6 inches (152 mm) o.c. around panel perimeter and 12 inches (305 mm) o.c. in center area of panel where nails will penetrate nailable substrate.

C. Filler Panels: Slip filler panels beneath field panels. Overlap and nest panels with each other, and nail panels to substrate, locating nails to blend with the embossed design. Lap panels to minimize joint visibility from entrance to room unless otherwise indicated. Space nails 6 inches (152 mm) o.c.

D. Cornice: Overlap and nest panels with each other, overlap the field or filler panels, and nail panels to substrate, locating nails to blend with the embossed design. Lap panels to minimize joint visibility from entrance to room unless otherwise indicated. Space nails 6 inches (152 mm) o.c. along the top edge and 12 inches (305 mm) o.c. along the bottom edge.

E. Moldings: Overlap and nest panels with each other, overlap the field and filler panels, and nail panels to substrate, locating nails to blend with the embossed design. Lap panels to minimize joint visibility from entrance to room unless otherwise indicated. Space nails 6 inches (152 mm) o.c. along the edges.

F. Tamping: Tamp edge of open seams lightly with rubber mallet and wood block, so that they close flush and nest snugly along edges with adjacent panels. Install sealant where tamping is insufficient to close seams.

G. Sealant: After ceiling panel installation, apply sealant to repaired panel joints that cannot be closed tightly after flattening the panels before installation or by tamping. Keep joints to receive sealant dry and free of debris. Apply and cure sealant according to manufacturer's written instructions.

1. Seal joints that are more than 1/32 inch (0.8 mm) and as necessary to prevent joint shadows.
2. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough or sculptural textures. Promptly remove excess and spillage of sealant as the work progresses.
3. Before field painting, cure sealant.

H. Touch Up: At completion of installation, touch up and restore damaged or defaced finish surfaces and nail heads.

3.6 PRIMING AND PAINTING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

C. Finish Painting: Apply as soon as possible after repair and installation according to applicable requirements in Section 090391 "Historic Treatment of Plain Painting".

3.7 HISTORIC METAL CEILING SCHEDULE

A. Treatment of Metal Ceiling MC-1:

1. Perform repair work in the shop or in the field.
2. Paint Removal: As specified in Section 050371 "Historic Decorative Metal Cleaning," except use no spray methods.
3. Rust Removal: As directed Chemical or Mechanical.
4. Repair: Flatten deformed panels and patch holes by filling with metal-patching compound.
5. Painted Finish: As specified in Section 090391 "Historic Treatment of Plain Painting.".

    a. Color: As directed.

6. Gilding: As specified in Section 090398 "Historic Treatment of Gilding.".

END OF SECTION 090353

SECTION 090391 - HISTORIC TREATMENT OF PLAIN PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of plain painting as follows:

1. Removing existing paint.
2. Repairing substrates.
3. Plain painting of historic surfaces, including staining and varnishing of historic wood.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090394 "Historic Treatment of Decorative Painting" for graining, marbleizing, stenciling, and striping on historic surfaces.
3. Section 090395 "Historic Treatment of Artistic Painting" for freehand painting and trompe l'oeil on historic surfaces.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

H. Modern Paint Materials: Paint materials not designed to match historic paint formulations but that may be required to match historic paint colors.

I. Plain Painting: For historic treatment, this means painting that requires attention to historic treatment requirements, but no special, decorative or artistic painting skill.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of painting.
2. Review methods and procedures related to historic treatment of painting and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of paint system and each color and gloss.

1. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
2. Label each Sample for location and application.

D. Product List: Printout of current MPI's "MPI Approved Products List" for each MPI-product category specified in paint systems, with the proposed product highlighted.

1.5 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer color matching of historic colors.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing painting. Experience only in new painting work is insufficient experience for historic treatment work.

B. Color Matching: Custom computer-match paint colors to colors indicated in historic painting schedule(s) at the end of Part 3 in the Historic Structure Report or on Drawings. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.

C. Mockups: Prepare mockups of historic treatment processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

1. Surface-preparation mockups using applicable specified methods of cleaning and other surface preparation.
2. Coating mockups to represent surfaces and conditions for application of each type of coating system.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinseable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

2.3 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As indicated with each paint system in historic painting schedule(s) at the end of Part 3, Match Architect's samples or as selected by Architect from full range of industry colors.

2.4 MODERN PAINT MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.5 MODERN PAINT MATERIAL MANUFACTURERS

2.6 MODERN PAINT MATERIALS

A. Primers and Sealers:

1. Primer Sealer, Latex, Interior: MPI #50.
    a. Basis-of-Design Product: As directed.
2. Primer, Latex, for Interior Wood: MPI #39.
    a. Basis-of-Design Product: As directed.
3. Primer Sealer, Alkyd, Interior: MPI #45.
    a. Basis-of-Design Product: As directed.
4. Undercoat, Enamel, Interior: MPI #46.
    a. Basis-of-Design Product: As directed.
5. Primer, Stain Blocking, Water Based: MPI #137.
    a. Basis-of-Design Product: As directed.
6. Alkyd, Sanding Sealer, Clear: MPI #102.
    a. Basis-of-Design Product: As directed.
7. Shellac: MPI #88.
    a. Basis-of-Design Product: As directed.
8. Stain, Semi-Transparent, for Interior Wood: MPI #90.
    a. Basis-of-Design Product: As directed.

B. Metal Primers:

1. Primer, Metal, Surface Tolerant: MPI #23.

a. Basis-of-Design Product: As directed.

2. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.

a. Basis-of-Design Product: As directed.

3. Primer, Rust-Inhibitive, Water Based: MPI #107.

a. Basis-of-Design Product: As directed.

C. Wood Primers:

1. Primer, Latex for Exterior Wood: MPI #6.

a. Basis-of-Design Product: As directed.

2. Primer, Alkyd for Exterior Wood: MPI #5.

a. Basis-of-Design Product: As directed.

D. Water-Based Paints:

1. Latex, Exterior Flat (Gloss Level 1): MPI #10.

a. Basis-of-Design Product: As directed.

2. Latex, Exterior Low Sheen (Gloss Levels 3-4): MPI #15.

a. Basis-of-Design Product: As directed.

3. Latex, Exterior Semigloss (Gloss Level 5): MPI #11.

a. Basis-of-Design Product: As directed.

4. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.

a. Basis-of-Design Product: As directed.

5. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

a. Basis-of-Design Product: As directed.

6. Latex, Interior, (Gloss Level 2): MPI #44.

a. Basis-of-Design Product: As directed.

7. Latex, Interior, (Gloss Level 3): MPI #52.

a. Basis-of-Design Product: As directed.

8. Latex, Interior, (Gloss Level 4): MPI #43.

a. Basis-of-Design Product: As directed.

9. Latex, Interior, Semigloss, (Gloss Level 5): MPI #54.

a. Basis-of-Design Product: As directed.

10. Latex, Interior, Gloss, (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.

a. Basis-of-Design Product: As directed.

11. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

a. Basis-of-Design Product: As directed.

12. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 2): MPI #144.

a. Basis-of-Design Product: As directed.

13. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 3): MPI #145.

a. Basis-of-Design Product: As directed.

14. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 4): MPI #146.

a. Basis-of-Design Product: As directed.

15. Latex, Interior, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.

a. Basis-of-Design Product: As directed.

16. Latex, Interior, Institutional Low Odor/VOC, Gloss (Gloss Level 6): MPI #148.

a. Basis-of-Design Product: As directed.

E. Solvent-Based Paints:

1. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.

a. Basis-of-Design Product: As directed.

2. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.

a. Basis-of-Design Product: As directed.

3. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.

a. Basis-of-Design Product: As directed.

4. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.

a. Basis-of-Design Product: As directed.

5. Alkyd, Interior, (Gloss Level 3): MPI #51.
    a. Basis-of-Design Product: As directed.
6. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.
    a. Basis-of-Design Product: As directed.
7. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.
    a. Basis-of-Design Product: As directed.

F. Floor Coatings:

1. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.
    a. Basis-of-Design Product: As directed.
2. Floor Paint, Latex, Gloss MPI #68.
    a. Basis-of-Design Product: As directed.
3. Floor Paint, Alkyd, Low Gloss (Gloss Level 6): MPI #59.
    a. Basis-of-Design Product: As directed.
4. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.
    a. Basis-of-Design Product: As directed.

G. Solvent-Based Varnishes:

1. Varnish, with UV Inhibitor, Exterior, Semigloss (Gloss Level 5): MPI #30.
    a. Basis-of-Design Product: As directed.
2. Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6): MPI #29.
    a. Basis-of-Design Product: As directed.
3. Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7): MPI #28.
    a. Basis-of-Design Product: As directed.
4. Varnish, Interior, Flat (Gloss Level 1): MPI #73.
    a. Basis-of-Design Product: As directed.
5. Varnish, Interior, Semigloss (Gloss Level 5): MPI #74.
    a. Basis-of-Design Product: As directed.

6. Varnish, Interior, Gloss (Gloss Level 6): MPI #75.

    a. Basis-of-Design Product: As directed.

H. Polyurethane Varnishes:

1. Varnish, Interior, Polyurethane, Oil-Modified, Gloss (Gloss Level 6): MPI #56.

    a. Basis-of-Design Product: As directed.

2. Varnish, Polyurethane, Moisture-Cured, Gloss (Gloss Level 6): MPI #31.

    a. Basis-of-Design Product: As directed.

2.7 PATCHING MATERIALS

A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

B. Metal Patching Compound: Two-part, polyester-resin, metal patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated due to corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.

C. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

D. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PAINTING, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before repainting.
4. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail. Do not use abrasive methods such as rotary sanding, rotary wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.

C. Heat Processes: Do not use torches, heat guns, or heat plates.

3.2 EXAMINATION

A. Examine substrates and conditions, with historic treatment specialist present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.

B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.
3. Gypsum Plaster: 12 percent.
4. Masonry (Clay and CMU): 12 percent.
5. Portland Cement Plaster: 12 percent.
6. Wood: 15 percent.

C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.3 PREPARATORY CLEANING

A. General: Use only the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous-metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous-metal cleaning. Clean to bright metal.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.4 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.

   a. Metal Substrates: If using wire brushes on metal , use brushes of same metal composition as metal being treated.
   b. Wood Substrates: Do not use wire brushes.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

   a. Equip units with pressure gages.
   b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
   c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
   d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
   e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material. Do not use other methods except as indicated as part of the historic treatment program and as approved by Architect.

C. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. As directed Rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

D. Paint Removal with Low-Odor, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. As directed Rinse with cold or hot water applied by low or medium-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

3.5 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Wood Substrate:

1. Repair wood defects including dents and gouges more than 1/8 inch (3 mm) or 1/4 inch (6 mm) in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.

C. Cementitious Material Substrate:

1. General: Repair defects including dents and chips more than 1/4 inch (6 mm) or 1/2 inch (13 mm) in size as directed and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.

D. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips more than 1/8 inch (3 mm) or 1/4 inch (6 mm) in size as directed and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

E. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (6 mm) or 1/8 inch (3 mm) deep or 1/2 inch (13 mm) or 1 inch (25 mm) across and all holes and cracks by filling with metal patching compound and sanding smooth. Remove burrs and protruding fasteners.
3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.6 PAINT APPLICATION, GENERAL

A. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

B. Apply a transition coat over incompatible existing coatings.

C. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.

D. Blending Plain Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection and provide on-site assistance when requested by Architect.

3.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 SURFACE-PREPARATION SCHEDULE

A. General: Before painting, prepare surfaces where indicated on Drawings for painting according to applicable requirements specified in this schedule.

1. Examine surfaces to evaluate each surface condition according to paragraphs below.
2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
3. Repair substrate defects according to "Substrate Repair" Article.

B. Surface Preparation for MPI DSD 0 Degree of Surface Degradation:

1. Surface Condition: Existing paint film in good condition and tightly adhered.
2. Paint Removal: Not required.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.

C. Surface Preparation for MPI DSD 1 Degree of Surface Degradation:

1. Surface Condition: Paint film cracked or broken but adhered.
2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.

D. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.

2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

E. Surface Preparation for MPI DSD 3 Degree of Surface Degradation:

1. Surface Condition: As directed Paint film severely deteriorated, obscuring fine architectural detail work because of paint-layer buildup and surface indicated to have paint completely removed.
2. Paint Removal: Completely remove paint film by hand-tool or chemical paint-removal methods. Remove rust.
3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

F. Surface Preparation for MPI DSD 4 Degree of Surface Degradation:

1. Surface Condition: Missing material, small holes and openings, and deteriorated or corroded substrate.
2. Substrate Preparation: Repair, replace, and treat substrate according to "Substrate Repair" Article and requirements in other Specification Sections.
3. Preparation for Painting: Sand substrate surfaces to smooth remaining paint film edges and prepare according to paint manufacturer's written instructions for substrate construction materials. Remove rust.
4. Painting: Paint as required for MPI DSD 2 degree of surface degradation.

3.10 EXTERIOR HISTORIC PAINTING SCHEDULE

A. Ferrous Metal Substrates: As directed Cast-iron facade and storefront or Wrought-iron railing and gate:

1. Alkyd System: MPI REX 5.1D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
d. Intermediate Coat: Alkyd, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior, semigloss (Gloss Level 5), MPI #94.
f. Topcoat: Alkyd, exterior, gloss (Gloss Level 6), MPI #9.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

B. Wood Columns, Beams, Ceilings, Siding and Fencing:

1. Latex System: MPI REX 6.2A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex for Exterior Wood, MPI #6.
d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex for Exterior Wood, MPI #6.
f. Intermediate Coat: Latex, exterior, matching topcoat.
g. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
h. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
i. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
j. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.2C system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

C. Wood Doors, Windows, Frames, Casings and Smooth Fasciae as directed:

1. Latex System: MPI REX 6.3A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
f. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
g. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
h. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
i. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.3B system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Alkyd, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3. Varnish System (Clear): MPI REX 6.3F.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
d. Intermediate Coat: Exterior varnish matching topcoat.
e. Topcoat: Varnish, with UV inhibitor, exterior, semigloss (Gloss Level 5), MPI #30.
f. Topcoat: Varnish, with UV inhibitor, exterior, gloss (Gloss Level 6), MPI #29.
g. Topcoat: Varnish, marine spar, exterior, gloss (Gloss Level 6), MPI #28.

D. Wood Deck and Stairs:

1. Latex Porch and Floor System over Alkyd Primer: MPI REX 6.5A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd/Oil for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd/Oil for Exterior Wood, MPI #5.
d. Intermediate Coat: Floor Paint, Latex, matching topcoat.
e. Topcoat: Floor paint, latex, low gloss, MPI #60.
f. Topcoat: Floor paint, latex, gloss, MPI #68.
g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd Floor Enamel System: MPI REX 6.5B system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.

d. Intermediate Coat: Floor enamel matching topcoat.
e. Topcoat: Floor paint, alkyd, low gloss, MPI #59.
f. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

E. Wood Shingle or Shake Siding:

1. Latex System: MPI REX 6.6A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Latex, exterior flat (Gloss Levels 1-2), MPI #10.
f. Topcoat: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
g. Topcoat: Latex, exterior semigloss (Gloss Level 5), MPI #11.
h. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.
i. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd System: MPI REX 6.6B system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood, MPI #5.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood, MPI #5.
d. Intermediate Coat: Latex, exterior, matching topcoat.
e. Topcoat: Alkyd, exterior flat (Gloss Level 1), MPI #8.
f. Topcoat: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
g. Topcoat: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3.11 INTERIOR HISTORIC PAINTING SCHEDULE

A. Ferrous Metal Substrates: Cast-iron grilles or Wrought-iron railing:

1. Latex System: MPI RIN 5.1N system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.

d. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Rust-Inhibitive, Water Based, MPI #107.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
f. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
g. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Rust-Inhibitive, Water Based, MPI #107.
h. Intermediate Coat: Latex matching topcoat.
i. Topcoat: Latex, interior, flat (Gloss Level 1), MPI #53.
j. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
k. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
l. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
m. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
n. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
o. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd System: MPI RIN 5.1E system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant, MPI #23.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant, MPI #23.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal, MPI #79.
f. Intermediate Coat: Alkyd, matching topcoat.
g. Topcoat: Alkyd, interior, flat (Gloss Level 1, MPI #49.
h. Topcoat: Alkyd, interior (Gloss Level 3), MPI #51.
i. Topcoat: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.
j. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

B. Wood Columns, Beams and Ceilings as directed:

1. Latex System over Latex Primer: MPI RIN 6.2D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.

i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Latex System over Alkyd Primer: MPI RIN 6.2A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Undercoat, Enamel, Interior, MPI #46.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior, MPI #46.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

C. Wood Doors, Windows, Frames and Moldings:

1. Latex System over Latex Primer: MPI RIN 6.3U system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
f. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Low-Odor Latex System over Latex Primer: MPI RIN 6.3V system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
f. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.

i. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
j. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3. Alkyd Varnish System (Clear): MPI RIN 6.3J.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Shellac, MPI #88.
c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Alkyd, Sanding Sealer, Clear, MPI #102.
d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Shellac, MPI #88.
e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Alkyd, Sanding Sealer, Clear, MPI #102.
f. Intermediate Coat: Interior varnish matching topcoat.
g. Topcoat: Varnish, interior, flat (Gloss Level 1), MPI #73.
h. Topcoat: Varnish, interior, semigloss (Gloss Level 5), MPI #74.
i. Topcoat: Varnish, interior, gloss (Gloss Level 6), MPI #75.

D. Wood Paneling, Casework and Millwork as directed:

1. Latex System over Latex Primer: MPI RIN 6.4T system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
f. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
g. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Low-Odor Latex System over Latex Primer: MPI RIN 6.4D system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood, MPI #39.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood, MPI #39.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
f. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.

i. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
j. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3. Latex System over Alkyd Primer: MPI RIN 6.4A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Undercoat, Enamel, Interior, MPI #46.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior, MPI #46.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior flat (Gloss Level 1), MPI #53.
f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.
i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Topcoat: Latex, interior, gloss (Gloss Level 6), MPI #114.
k. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

E. Wood Floors and Stairs:

1. Alkyd Floor Enamel System: MPI RIN 6.5A system over a transition coat.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
d. Intermediate Coat: Floor enamel matching topcoat.
e. Topcoat: Floor paint, alkyd, low gloss, MPI #59.
f. Topcoat: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
g. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
h. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Polyurethane Varnish System (Clear): MPI RIN 6.5C.

a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with topcoat.
d. Intermediate Coat: Interior varnish matching topcoat.
e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss, MPI #56.

3. Moisture-Cured Polyurethane System (over Stain): MPI RIN 6.5L.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Stain, Semi-Transparent, for Interior Wood, MPI #90.
    c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Stain, Semi-Transparent, for Interior Wood, MPI #90.
    d. Intermediate Coat: Moisture-cured polyurethane varnish matching topcoat.
    e. Topcoat: Varnish, polyurethane, moisture cured, gloss (Gloss Level 6), MPI #31.
    f. Stain Color: Match adjacent, cleaned wood of same type, color indicated in the Historic Structure Report or color indicated on Drawings.

F. Plaster:

1. Low-Odor Latex System over Waterborne Primer: MPI RIN 9.2M system over a transition coat.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer Sealer, Latex, Interior, MPI #50.
    c. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based, MPI #137.
    d. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior, MPI #50.
    e. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based, MPI #137.
    f. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
    g. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
    h. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
    i. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
    j. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
    k. Topcoat: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
    l. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Latex System over Alkyd Primer: MPI RIN 9.2K system over a transition coat.

    a. Prime Coat: For MPI DSD 1 degree of surface degradation, touch up with topcoat.
    b. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer Sealer, Alkyd, Interior, MPI #45.
    c. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat Primer Sealer, Alkyd, Interior, MPI #45.
    d. Intermediate Coat: Latex matching topcoat.
    e. Topcoat: Latex, interior, flat (Gloss Level 1), MPI #53.
    f. Topcoat: Latex, interior (Gloss Level 2), MPI #44.
    g. Topcoat: Latex, interior (Gloss Level 3), MPI #52.
    h. Topcoat: Latex, interior (Gloss Level 4), MPI #43.

i. Topcoat: Latex, interior, semigloss (Gloss Level 5), MPI #54.
j. Color: Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

END OF SECTION 090391

SECTION 090394 - HISTORIC TREATMENT OF DECORATIVE PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative painting in the form of graining, marbleizing, stenciling and striping applied over substrates in good condition.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090391 "Historic Treatment of Plain Painting" for removing paint, substrate repair, and plain painting of historic surfaces.
3. Section 090395 "Historic Treatment of Artistic Painting" for freehand painting and trompe l'oeil on historic surfaces.

1.2 DEFINITIONS

A. Decorative Painting: Painting requiring a higher level of skill than plain painting. This classification includes graining, marbleizing, stenciling, and striping.

B. Glazing: Applying translucent paint material (glaze coat) to protect paint beneath it and impart a more uniform surface gloss.

C. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

D. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

E. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

F. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

G. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

H. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

I. Graining: Decorative painting that simulates wood.

J. Marbleizing: Decorative painting that simulates marble or other stone.

K. Modern Paint Materials: Paint materials not designed to match historic paint formulations but that may be required to match historic paint colors.

L. Plain Painting: For historic treatment, this means painting that requires attention to historic treatment requirements, but no special, decorative or artistic painting skill.

M. Stenciling: Decorative paint designs applied using pattern cutouts.

N. Striping: Decorative painting in striped patterns.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative painting.
2. Review methods and procedures related to historic treatment of decorative painting and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
2. Label each Sample for location and application.

C. Product List: Printout of current MPI's "MPI Approved Products List" for each MPI-product category specified, with the proposed product highlighted.

1.5 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer color matching of historic colors.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing, decorative painting. Experience only in new painting work is insufficient experience for historic treatment work.

B. Color Matching: Custom computer-match paint colors to colors indicated in decorative painting schedule(s) at the end of Part 3, in the Historic Structure Report or on Drawings as directed. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.

C. Mockups: Prepare mockups of historic treatment processes for each type of decorative painting and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide paint materials that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat, provide products recommended in writing by manufacturer for use over substrate paint system or on substrate indicated.

B. Colors: As indicated in decorative painting schedule(s) at the end of Part 3, Match Architect's samples or As selected by Architect from full range of industry colors.

2.2 MODERN PAINT MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

C. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the decorative paint material.

D. Glaze Coat: Manufacturer's standard translucent paint material for application as directed.

2.3 MODERN PAINT MATERIAL MANUFACTURERS

2.4 MODERN PAINT MATERIALS

A. Water-Based Paints:

1. Latex, Exterior, Low Sheen (Gloss Levels 3-4): MPI #15.

    a. Basis-of-Design Product: As directed.

2. Latex, Exterior, Semigloss (Gloss Level 5): MPI #11.

    a. Basis-of-Design Product: As directed.

3. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.

a. Basis-of-Design Product: As directed.

4. Latex, Interior, Flat (Gloss Level 1): MPI #53.

a. Basis-of-Design Product: As directed.

5. Latex, Interior (Gloss Level 2): MPI #44.

a. Basis-of-Design Product: As directed.

6. Latex, Interior (Gloss Level 3): MPI #52.

a. Basis-of-Design Product.

7. Latex, Interior (Gloss Level 4): MPI #43.

a. Basis-of-Design Product.

8. Latex, Interior, Semigloss (Gloss Level 5): MPI #54.

a. Basis-of-Design Product: As directed.

9. Latex, Interior, Gloss (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.

a. Basis-of-Design Product: As directed.

10. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

a. Basis-of-Design Product: As directed.

11. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 2): MPI #144.

a. Basis-of-Design Product: As directed.

12. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 3): MPI #145.

a. Basis-of-Design Product: As directed.

13. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 4): MPI #146.

a. Basis-of-Design Product: As directed.

14. Latex, Interior, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.

a. Basis-of-Design Product: As directed.

15. Latex, Interior, Institutional Low Odor/VOC, Gloss (Gloss Level 6): MPI #148.

a. Basis-of-Design Product: As directed.

B. Solvent-Based Paints:

1. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.
    a. Basis-of-Design Product: As directed.
2. Alkyd, Exterior, Gloss (Gloss Level 6): MPI #9.
    a. Basis-of-Design Product: As directed.
3. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.
    a. Basis-of-Design Product: As directed.
4. Alkyd, Interior (Gloss Level 3): MPI #51.
    a. Basis-of-Design Product: As directed.
5. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.
    a. Basis-of-Design Product: As directed.
6. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.
    a. Basis-of-Design Product: As directed.

C. Floor Coatings:

1. Floor Paint, Latex, Low Gloss (Maximum Gloss Level 3): MPI #60.
    a. Basis-of-Design Product: As directed.
2. Floor Paint, Latex, Gloss: MPI #68.
    a. Basis-of-Design Product: As directed.
3. Floor Paint, Alkyd, Low Gloss (Gloss Level 6): MPI #59.
    a. Basis-of-Design Product: As directed.
4. Floor Enamel, Alkyd, Gloss (Gloss Level 6): MPI #27.
    a. Basis-of-Design Product: As directed.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF DECORATIVE PAINTING, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion before painting.

2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before painting.
4. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

3.2 PAINT APPLICATION, GENERAL

A. Substrate Surface Preparation: Before painting, prepare surfaces for painting according to manufacturer's written instructions for each substrate condition.

B. Apply a transition coat over incompatible existing coatings and substrate materials.

3.3 DECORATIVE PAINTING APPLICATIONS

A. General: Apply decorative painting with adequate illumination that does not distort the colors of surfaces or paint being applied.

B. Graining: Treat each grained substrate item or component as a separate decorative pattern, differentiating individually grained pieces. Do not overlay a single grain pattern over multiple grained pieces.

1. Graining Pattern: Match pattern indicated on Drawings, design reference sample, existing wood graining to be replicated, existing wood to be imitated or species and grain of wood to be imitated.

a. Location of Pattern to be Matched: As directed.

C. Marbleizing: Treat each marbleized item as a separate decorative pattern, differentiating individually marbleized pieces. Do not overlay a single marbleized pattern over multiple marbleized pieces.

1. Marbleizing Pattern Match pattern indicated on Drawings, design reference sample, existing marbleizing to be replicated or existing marble to be imitated as directed.

a. Location of Pattern to be Matched: As directed.

D. Stenciling Pattern: Match stenciled design indicated on Drawings, design reference sample or stenciled design to be replicated.

1. Location of Pattern to be Matched: As directed.

E. Striping Pattern: Match pattern indicated on Drawings, design reference sample or striping pattern to be replicated as directed.

1. Location of Pattern to be Matched: As directed.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR DECORATIVE PAINTING SCHEDULE

A. Marbleizing, Graining, Stenciling on Painted Doors, Beams and Ceilings or Walls As Directed:

1. Latex paint over a transition coat.

    a. Type: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
    b. Type: Latex, exterior semigloss (Gloss Level 5), MPI #11.
    c. Type: Latex, exterior gloss (Gloss Level 6), MPI #119.
    d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd paint over a transition coat.

    a. Type: Alkyd, exterior semigloss (Gloss Level 5), MPI #94.
    b. Type: Alkyd, exterior gloss (Gloss Level 6), MPI #9.
    c. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

B. Stenciling, Striping on Painted Wood Floor or Concrete Floor As Directed:

1. Latex floor paint over a transition coat.

    a. Type: Floor paint, latex, low gloss, MPI #60.
    b. Type: Floor paint, latex, gloss, MPI #68.
    c. Nonslip Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
    d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd floor paint over a transition coat.

    a. Type: Floor paint, alkyd, low gloss, MPI #59.
    b. Type: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
    c. Nonslip Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
    d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3.6 INTERIOR DECORATIVE PAINTING SCHEDULE

A. Marbleizing, Graining, Stenciling on Painted Doors, Beams Ceilings and Walls As Directed:

1. Latex paint over a transition coat.

   a. Type: Latex, interior, flat (Gloss Level 1), MPI #53.
   b. Type: Latex, interior (Gloss Level 2), MPI #44.
   c. Type: Latex, interior (Gloss Level 3), MPI #52.
   d. Type: Latex, interior (Gloss Level 4), MPI #43.
   e. Type: Latex, interior, semigloss (Gloss Level 5), MPI #54.
   f. Type: Latex, interior, gloss (Gloss Level 6), MPI #114.
   g. Type: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143.
   h. Type: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
   i. Type: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
   j. Type: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
   k. Type: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
   l. Type: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
   m. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd Paint over a transition coat.

   a. Type: Alkyd, interior, flat (Gloss Level 1), MPI #49.
   b. Type: Alkyd, interior (Gloss Level 3), MPI #51.
   c. Type: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.
   d. Type: Alkyd, interior, gloss (Gloss Level 6), MPI #48.
   e. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

B. Stenciling, Striping on Painted Wood Floor or Concrete Floor As directed:

1. Latex floor paint over a transition coat.

   a. Type: Floor paint, latex, low gloss, MPI #60.
   b. Type: Floor paint, latex, gloss, MPI #68.
   c. Nonslip Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
   d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd floor paint over a transition coat.

   a. Type: Floor paint, alkyd, low gloss, MPI #59.
   b. Type: Floor enamel, alkyd, gloss (Gloss Level 6), MPI #27.
   c. Nonslip Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

END OF SECTION 090394

SECTION 090395 - HISTORIC TREATMENT OF ARTISTIC PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of artistic painting in the form of freehand painting and trompe l'oeil applied over substrates in good condition.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090391 "Historic Treatment of Plain Painting" for removing paint, substrate repair, and plain painting of historic surfaces.
3. Section 090394 "Historic Treatment of Decorative Painting" for graining, marbleizing, stenciling, and striping on historic surfaces.

1.2 DEFINITIONS

A. Artistic Painting: Painting requiring a higher level of skill than plain painting. This classification includes freehand painting and trompe l'oeil.

B. Freehand Painting: Artistic polychromatic painting applied using only a paintbrush.

C. Glazing: Applying translucent paint material (glaze coat) to protect paint beneath it and impart a more uniform surface gloss.

D. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

E. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

F. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

G. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

H. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

I. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

J. Modern Paint Materials: Paint materials not designed to match historic paint formulations but that may be required to match historic paint colors.

K. Plain Painting: For historic treatment, this means painting that requires attention to historic treatment requirements, but no special, decorative or artistic painting skill.

L. Trompe L'oeil: Artistic painting that simulates three-dimensional architectural detailing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of artistic painting.
2. Review methods and procedures related to historic treatment of artistic painting and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Samples: For each exposed product and for each color and texture specified.

1. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
2. Label each Sample for location and application.

C. Product List: Printout of current MPI's "MPI Approved Products List" for each MPI-product category specified, with the proposed product highlighted.

1.5 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer color matching of historic colors.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing, artistic painting. Experience only in new painting work is insufficient experience for historic treatment work.

B. Color Matching: Custom computer-match paint colors to colors indicated in artistic painting schedule(s) at the end of Part 3, in the Historic Structure Report or on Drawings as directed. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.

C. Mockups: Prepare mockups of historic treatment processes for each type of artistic painting and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set

quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide paint materials that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat, provide products recommended in writing by manufacturer for use over substrate paint system or on substrate indicated.

B. Colors: As indicated in artistic painting schedule(s) at the end of Part 3, Match Architect's samples or As selected by Architect from full range of industry colors as directed.

2.2 MODERN PAINT MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

C. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the artistic paint material.

D. Glaze Coat: Manufacturer's standard translucent paint material for application as directed.

2.3 MODERN PAINT MATERIAL MANUFACTURERS

2.4 MODERN PAINT MATERIALS

A. Water-Based Paints:

1. Latex, Exterior, Low Sheen (Gloss Levels 3-4): MPI #15.
    a. Basis-of-Design Product: As directed.
2. Latex, Exterior, Semigloss (Gloss Level 5): MPI #11.
    a. Basis-of-Design Product: As directed.
3. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.
    a. Basis-of-Design Product: As directed.

4. Latex, Interior, Flat (Gloss Level 1): MPI #53.

    a. Basis-of-Design Product: As directed.

5. Latex, Interior (Gloss Level 2): MPI #44.

    a. Basis-of-Design Product: As directed.

6. Latex, Interior (Gloss Level 3): MPI #52.

    a. Basis-of-Design Product: As directed.

7. Latex, Interior (Gloss Level 4): MPI #43.

    a. Basis-of-Design Product: As directed.

8. Latex, Interior, Semigloss (Gloss Level 5): MPI #54.

    a. Basis-of-Design Product: As directed.

9. Latex, Interior, Gloss (Gloss Level 6, except Minimum Gloss of 65 Units at 60 Degrees): MPI #114.

    a. Basis-of-Design Product: As directed.

10. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

    a. Basis-of-Design Product: As directed.

11. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 2): MPI #144.

    a. Basis-of-Design Product: As directed.

12. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 3): MPI #145.

    a. Basis-of-Design Product: As directed.

13. Latex, Interior, Institutional Low Odor/VOC (Gloss Level 4): MPI #146.

    a. Basis-of-Design Product: As directed.

14. Latex, Interior, Institutional Low Odor/VOC, Semigloss (Gloss Level 5): MPI #147.

    a. Basis-of-Design Product: As directed.

15. Latex, Interior, Institutional Low Odor/VOC, Gloss (Gloss Level 6): MPI #148.

    a. Basis-of-Design Product: As directed.

B. Solvent-Based Paints:

1. Alkyd, Exterior, Semigloss (Gloss Level 5): MPI #94.

a. Basis-of-Design Product: As directed.

2. Alkyd, Exterior, Gloss (Gloss Level 6): MPI #9.

a. Basis-of-Design Product: As directed.

3. Alkyd, Interior, Flat (Gloss Level 1): MPI #49.

a. Basis-of-Design Product: As directed.

4. Alkyd, Interior (Gloss Level 3): MPI #51.

a. Basis-of-Design Product: As directed.

5. Alkyd, Interior, Semigloss (Gloss Level 5): MPI #47.

a. Basis-of-Design Product: As directed.

6. Alkyd, Interior, Gloss (Gloss Level 6): MPI #48.

a. Basis-of-Design Product: As directed.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF ARTISTIC PAINTING, GENERAL

A. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion before painting.
2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before painting.
4. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

3.2 PAINT APPLICATION, GENERAL

A. Substrate Surface Preparation: Before painting, prepare surfaces for painting according to manufacturer's written instructions for each substrate condition.

B. Apply a transition coat over incompatible existing coatings and substrate materials.

3.3 ARTISTIC PAINTING APPLICATIONS

A. General: Apply artistic painting with adequate illumination that does not distort the colors of surfaces or paint being applied.

B. Freehand Painting Artwork Design: Match artwork indicated on Drawings, design reference sample or artwork to be replicated or touched up.

1. Location of Design to be Matched: As directed.

C. Trompe L'oeil Artwork Design: Match artwork indicated on Drawings, design reference sample or artwork to be replicated or touched up.

1. Location of Design to be Matched: As directed.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR ARTISTIC PAINTING SCHEDULE

A. Freehand Painting, Trompe L'oeil on Painted, Wood Siding or Brick Wall As directed:

1. Latex paint over a transition coat.

a. Type: Latex, exterior, low sheen (Gloss Levels 3-4), MPI #15.
b. Type: Latex, exterior, semigloss (Gloss Level 5), MPI #11.
c. Type: Latex, exterior, gloss (Gloss Level 6), MPI #119.
d. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd paint over a transition coat.

a. Type: Alkyd, exterior, semigloss (Gloss Level 5), MPI #94.
b. Type: Alkyd, exterior, gloss (Gloss Level 6), MPI #9.
c. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

3.6 INTERIOR ARTISTIC PAINTING SCHEDULE

A. Freehand Painting or Trompe L'oeil on Painted Ceilings and Walls:

1. Latex paint over a transition coat.

a. Type: Latex, interior, flat (Gloss Level 1), MPI #53.
b. Type: Latex, interior (Gloss Level 2), MPI #44.

c. Type: Latex, interior (Gloss Level 3), MPI #52.
d. Type: Latex, interior (Gloss Level 4), MPI #43.
e. Type: Latex, interior, semigloss (Gloss Level 5), MPI #54.
f. Type: Latex, interior, gloss (Gloss Level 6), MPI #114.
g. Type: Latex, interior, institutional low odor/VOC flat (Gloss Level 1), MPI #143.
h. Type: Latex, interior, institutional low odor/VOC (Gloss Level 2), MPI #144.
i. Type: Latex, interior, institutional low odor/VOC (Gloss Level 3), MPI #145.
j. Type: Latex, interior, institutional low odor/VOC (Gloss Level 4), MPI #146.
k. Type: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5), MPI #147.
l. Type: Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6), MPI #148.
m. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

2. Alkyd paint over a transition coat.

a. Type: Alkyd, interior, flat (Gloss Level 1), MPI #49.
b. Type: Alkyd, interior (Gloss Level 3), MPI #51.
c. Type: Alkyd, interior, semigloss (Gloss Level 5), MPI #47.
d. Type: Alkyd, interior, gloss (Gloss Level 6), MPI #48.
e. Color(s): Match Munsell Color 10 G 8/2, Plochere Color System #8da399, colors indicated in the Historic Structure Report or colors indicated on Drawings.

END OF SECTION 090395

SECTION 090398 - HISTORIC TREATMENT OF GILDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of gilding on substrates in good condition.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 090391 "Historic Treatment of Plain Painting" for substrate repair and for removing painting from and for plain painting on historic substrates if required before gilding.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of gilding.
2. Review methods and procedures related to historic treatment of gilding and fire protection.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic gilding specialist with expertise in matching and infilling existing gilding. Experience only in painting work is insufficient experience for historic treatment of gilding.

B. Mockups: Provide mockups for each type of gilding and substrate indicated and each metallic leaf required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

PART 2 - PRODUCTS

2.1 GILDING MATERIALS

A. Metallic Leaf: 12K gold (white gold), 18K gold, 22K gold, 23K gold, 23.5K gold, 23.5K red gold or Palladium.

B. Sizing: Oil type.

PART 3 - EXECUTION

3.1 GILDING APPLICATION

A. Comply with manufacturers' written instructions for application methods unless otherwise indicated in this Section.

B. Apply gilding with adequate illumination that does not distort the condition of surfaces or materials being applied.

C. Apply sizing and metallic leaf to surfaces after substrate and nearby painting is completed and dry. Gently press metallic leaf into sizing with a soft brush or a cotton or velvet cloth to fully adhere it to the surface. Gently remove overlapped edges with a soft brush after the sizing has fully dried.

END OF SECTION 090398

SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

B. Work of this Section is affected by Moisture Vapor Emission Control.

1.2 DEFINITIONS

A. MVE: Moisture vapor emission.

B. MVER: Moisture vapor emission rate.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preinstallation testing reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:

1. MVER: As directed Maximum 15 lb of water/1000 sq. ft. (6.80 kg of water/92.9 sq. m), 25 lb of water/1000 sq. ft. (11.34 kg of water/92.9 sq. m) or 30 lb of water/1000 sq. ft. (13.61 kg of water/92.9 sq. m) when tested according to ASTM F1869.
2. Relative Humidity: As directed Maximum 100 or 90 percent when tested according to ASTM F2170 using in situ probes.

B. Water-Vapor Transmission: As directed Through MVE-control system, maximum 0.10 perm (5.75 ng/Pa x s x sq. m), 0.02 perm (1.15 ng/Pa x s x sq. m) or 0.06 perm (3.45 ng/Pa x s x sq. m) when tested according to ASTM E96/E96M.

C. Tensile Bond Strength: For MVE-control system, greater than 200 psi (1.38 MPa) with failure in the concrete according to ASTM D7234.

2.2 MVE-CONTROL SYSTEM

A. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi (20.68-MPa) compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's gypsum or hydraulic cement-based underlayment as directed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Preinstallation Testing:

1. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests as directed.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
3. Moisture Testing: As directed Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.

4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. (9.29-sq. m) area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.

    a. Proceed with installation only where tensile bond strength is greater than 200 psi (1.38 MPa) with failure in the concrete.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

3.2 INSTALLATION

A. General: Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

E. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

F. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

G. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 090561.13

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Sustainable Design Submittals: As directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As directed.

B. STC Rating: As indicated, 51, minimum

C. Gypsum Shaftliner Board:

1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.

2. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch (25.4 mm) thick, and with double beveled long edges.

3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C1658/C1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch (25.4 mm) thick, and with double beveled long edges.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As directed.
2. Minimum Base-Metal Thickness: As directed.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.

1. Minimum Base-Metal Thickness: As directed.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm) thick.

I. Finish Panels: As indicated. Gypsum board as specified in Section 092900 "Gypsum Board.", Gypsum veneer plaster as specified in Section 092613, "Gypsum Veneer Plastering.", Cementitious backer units as specified in Section 092900 "Gypsum Board." Cementitious backer units as specified in Section 093013 "Ceramic Tiling" or as directed.

J. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board or Section 092613 "Gypsum Veneer Plastering."

2.3 AUXILIARY MATERIALS

A. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" and Section 092613 "Gypsum Veneer Plastering" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

D. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).

E. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged.

D. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

E. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

F. Penetrations: Install supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

G. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

H. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

I. Control Joints: Install control joints as directed according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

J. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

K. Gypsum Board Cants: At projections into shaft exceeding 4 inches (102 mm) where indicated, install gypsum board cants covering tops of projections.

L. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

M. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation reports for as directed.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
2. Protective Coating: ASTM A653/A653M, G40 (Z120), ASTM A653/A653M, G60 (Z180), Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks or as directed.

1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection as directed.
2. Depth: As directed.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing as directed for minimum vertical movement.

2. Single Long-Leg Track System: ASTM C645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs, friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
3. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: As directed.

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As directed.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Steel Thickness: As directed.
2. Depth: As directed.

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
   1. Configuration: Asymmetrical or hat shaped or as directed.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: As directed.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

   1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES as appropriate for the substrate.

      a. Uses: Securing hangers to structure.
      b. Type: As directed.
      c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
      d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M) or as directed.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, in size indicated on Drawings Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

   1. Depth: As directed.

E. Furring Channels (Furring Members):

   1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.

2. Steel Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks or as directed.

    a. Minimum Base-Steel Thickness: As directed.
    b. Depth: As directed.

3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.

    a. Minimum Base-Steel Thickness: As directed.

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support as directed.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092300 - GYPSUM PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum plastering on expanded-metal lath.
2. Gypsum plastering on unit masonry.
3. Gypsum plastering on monolithic concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

B. Sound-Transmission Characteristics: Where indicated, provide gypsum plaster assemblies identical to those of assemblies tested for STC ratings according to ASTM E90 and classified according to ASTM E413 by a qualified testing agency.

2.2 EXPANDED-METAL LATH

A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.

1. Paper Backing: Kraft paper factory bonded to back of lath.
2. Diamond-Mesh Lath:

    a. Type: Flat or Self-furring.
    b. Weight: 2.5 lb/sq. yd. (1.4 kg/sq. m) or 3.4 lb/sq. yd. (1.8 kg/sq. m) and as directed.

3. Flat-Rib Lath: Rib depth of not more than 1/8 inch (3 mm), or as directed.
4. Rib Lath: As directed.

2.3 ACCESSORIES

A. General: Comply with ASTM C841, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:
   1. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
   2. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
   3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
      a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
      b. Smallnose cornerbead with perforated flanges; use on curved corners.
      c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
      d. Bullnose cornerbead, radius 3/4-inch (19-mm) minimum, with expanded flanges; use at locations indicated on Drawings.
   4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
   5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
   6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
   7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

C. Plastic Accessories: Manufactured from high-impact PVC.
   1. Cornerbeads: With perforated flanges.
      a. Smallnose cornerbead; use unless otherwise indicated.
      b. Bullnose cornerbead, radius 3/4-inch (19-mm) minimum; use at locations indicated on Drawings.
   2. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
      a. Square-edge style; use unless otherwise indicated.
      b. Bullnose style, radius 3/4-inch (19-mm) minimum; use at locations indicated on Drawings.
   3. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
   4. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged as directed wide reveal; with perforated concealed flanges.

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Bonding Compound: ASTM C631.

C. Fasteners for Attaching Metal Lath to Substrates: ASTM C841.

D. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter unless otherwise indicated.

E. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of rated assembly.

F. Mix Additives: Use gypsum plaster accelerators and retarders from plaster manufacturer if required by Project conditions. Use only additives that manufacturer recommends in writing for use with plaster to which it is added.

2.5 BASE-COAT PLASTER MATERIALS

A. Lightweight-Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.

B. Gypsum Neat Plaster: ASTM C28/C28M, for use with job-mixed aggregates.

C. Gypsum Wood-Fibered Plaster: ASTM C28/C28M, for use as is or with the addition of job-mixed sand in up to equal proportions by weight.

D. High-Strength Gypsum Neat Plaster: ASTM C28/C28M, with a minimum, average, dry compressive strength of 2800 psi (19 MPa) according to ASTM C472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.

E. Aggregates for Base-Coat Plasters: ASTM C35, sand and perlite.

2.6 FINISH-COAT PLASTER MATERIALS

A. Gypsum Gaging Plaster: ASTM C28/C28M.

B. Gypsum Ready-Mixed Finish Plaster: Manufacturer's standard, mill-mixed, gaged, interior finish.

C. High-Strength Gypsum Gaging Plaster: ASTM C28/C28M, with a minimum, average, dry compressive strength of 5000 psi (34 MPa) according to ASTM C472 for a neat mix.

D. Lime: ASTM C206, Type S, special finishing hydrated lime.

E. Lime: ASTM C206, Type N, normal finishing hydrated lime.

F. Aggregates for Float Finishes: ASTM C35, sand or perlite or as directed; graded according to ASTM C842.

2.7 PLASTER MIXES

A. Mixing: Comply with ASTM C842 and manufacturer's written instructions for applications indicated.

B. Mix Additives: Use accelerators and retarders, if required by Project conditions, according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

B. STC-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

C. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

D. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.2 INSTALLING EXPANDED-METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C841.

3.3 INSTALLING ACCESSORIES

A. General: Install according to ASTM C841.

B. Cornerbeads: Install at external corners.

C. Casing Beads: Install at terminations of plasterwork, except where plaster passes behind and is concealed by other work and where metal screeds, bases, or frames act as casing beads.

D. Control Joints: Locate as indicated on Drawings.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C842.

B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.

C. Base-Coat Plaster:

1. Over Expanded-Metal Lath:

   a. Scratch Coat: As directed.
   b. Brown Coat: As directed.

2. Over Unit Masonry: As directed.
3. Over Monolithic Concrete: Gypsum neat plaster with job-mixed sand or as directed.

D. Finish Coats:

1. Smooth-Troweled Finishes: As directed.
2. Float Finishes: Gypsum gaging plaster and lime putty or as directed.
3. Sprayed Finishes: Gypsum ready-mixed finish plaster applied to match Architect's sample or as directed.
4. Textured Finishes: Gypsum ready-mixed finish plaster applied to match Architect's sample or as directed.

E. Concealed Plaster:

1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.5 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION 092300

SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior vertical plasterwork (stucco).
2. Exterior horizontal and nonvertical plasterwork (stucco).
3. Interior vertical plasterwork.
4. Interior horizontal and nonvertical plasterwork.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each type of factory-prepared finish coat and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

2.2 METAL LATH

A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.

1. Diamond-Mesh Lath: Flat or Self-furring or ad directed.
2. Flat-Rib Lath: Rib depth of not more than 1/8 inch (3 mm), or as directed.
3. 3/8-Inch (10-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m), 4 lb/sq. yd. (2.2 kg/sq. m) or as directed.

B. Wire-Fabric Lath:

1. Welded-Wire Lath: ASTM C933; self-furring, 1.4 lb/sq. yd. (0.8 kg/sq. m), 1.95 lb/sq. yd. (1.1 kg/sq. m) or as directed.

2. Woven-Wire Lath: ASTM C1032; self-furring, with stiffener wire backing, 1.4 lb/sq. yd. (0.8 kg/sq. m).

C. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper, Grade B, Style 1a vapor-retardant paper, or as directed.

1. Provide paper-backed lath unless otherwise indicated.

2.3 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 (Z180) zinc coating.
2. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
3. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized-zinc coating.
4. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel or as directed.
    a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
    b. Smallnose cornerbead with perforated flanges; use on curved corners.
    c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
    d. Bullnose cornerbead, radius 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.
5. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel or as directed; square-edged style; with expanded flanges.
6. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel or as directed; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
7. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel or as directed; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
8. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel or as directed; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

C. Plastic Accessories: Manufactured from high-impact PVC.

1. Cornerbeads: With perforated flanges.
    a. Smallnose cornerbead; use unless otherwise indicated.
    b. Bullnose cornerbead, radius 3/4-inch (19-mm) minimum; use at locations indicated on Drawings.

2. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.

   a. Square-edge style; use unless otherwise indicated.
   b. Bullnose style, radius 3/4-inch (19-mm) minimum; use at locations indicated on Drawings.

3. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
4. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged as directed, wide reveal; with perforated concealed flanges.

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.

C. Bonding Compound: ASTM C932.

D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter unless otherwise indicated.

F. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2.5 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, or as directed.

   1. Color for Finish Coats: White or Gray or as directed.

B. Masonry Cement: ASTM C91, Type N.

   1. Color for Finish Coats: White or Gray or as directed.

C. Plastic Cement: ASTM C1328.

D. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color as directed.

E. Lime: ASTM C206, Type S; or ASTM C207, Type S.

F. Sand Aggregate: ASTM C897.

1. Color for Job-Mixed Finish Coats: White or as directed.

G. Perlite Aggregate: ASTM C35.

H. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Color: As directed.

I. Acrylic-Based Finish Coatings: Factory-mixed acrylic-emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes.

1. Color: As directed.

2.6 PLASTER MIXES

A. General: Comply with ASTM C926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to ¾, 3/4 to 1-1/2, or as directed parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to ¾, 3/4 to 1-1/2, or as directed parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2. Masonry Cement Mixes:

a. Scratch Coat: Mix 1 part masonry cement and 2-1/2 to 4 parts aggregate.
b. Brown Coat: Mix 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.

3. Portland and Masonry Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

4. Plastic Cement Mixes:

a. Scratch Coat: Mix 1 part plastic cement and 2-1/2 to 4 parts aggregate.
b. Brown Coat: Mix 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.

5. Portland and Plastic Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Base-Coat Mixes for Use over Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

D. Base-Coat Mixes for Use over Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

E. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 or 1-1/2 to 2 or as directed parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
2. Masonry Cement Mix: Use 1 part masonry cement and 1-1/2 to 3 parts aggregate.
3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
4. Plastic Cement Mix: Use 1 part plastic cement and 1-1/2 to 3 parts aggregate.

F. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, acrylic-based finish coatings or as directed, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Prepare smooth, solid substrates for plaster according to ASTM C926.

B. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

C. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.2 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C1063.

3.3 INSTALLING ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install lath-type, external-corner reinforcement, cornerbead as directed at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Locate as indicated on Drawings.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C926.

B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.

C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch (19-mm) total thickness, as follows:

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 1/2-inch (13-mm) total thickness, 3/4-inch (19-mm) total thickness or as directed for metal lath on concrete, as follows:

1. Portland cement mixes.
2. Masonry cement mixes.
3. Portland and masonry cement mixes.
4. Plastic cement mixes.
5. Portland and plastic cement mixes.

E. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch (10-mm) thickness on masonry, 1/4-inch (6-mm) thickness on concrete or as directed, as follows:

1. Portland cement mix.
2. Masonry cement mix.
3. Portland and masonry cement mix.
4. Plastic cement mix.
5. Portland and plastic cement mix.

F. Ceilings; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 1/4-inch (6-mm) thickness on concrete, as follows:

1. Portland cement mix.
2. Masonry cement mix.
3. Portland and masonry cement mix.
4. Plastic cement mix.
5. Portland and plastic cement mix.

G. Plaster Finish Coats: Apply to provide as directed.

H. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

I. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

J. Concealed Interior Plasterwork:

1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.5 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

END OF SECTION 092400

SECTION 092613 - GYPSUM VENEER PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum veneer plaster and gypsum base for interior veneer plaster.
2. Gypsum veneer plaster over interior cementitious backer units.
3. Gypsum veneer plaster over interior masonry surfaces.
4. Gypsum veneer plaster over interior monolithic concrete surfaces.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-load-bearing steel framing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show locations, fabrication, and installation of control joints, reveals, and trim; include plans, elevations, sections, details of components, and attachments to other work.

D. Samples: For each trim accessory and textured finish on rigid backing.

1.3 QUALITY ASSURANCE

A. Mockups: Provide mockups of ceilings and partitions in sizes of at least 100 sq. ft. (9 sq. m).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM VENEER PLASTER

A. One-Component Gypsum Veneer Plaster: ASTM C587, ready-mixed, smooth, finish-coat veneer plaster formulated for application directly over substrate without use of separate base-coat material.

B. High-Strength, One-Component Gypsum Veneer Plaster: ASTM C587, ready-mixed, smooth, finish-coat veneer plaster containing mill-mixed, fine silica sand; with a compressive strength of 3000 psi (20 MPa) when tested according to ASTM C472; and formulated for application directly over substrate without use of separate base-coat material.

C. Two-Component Gypsum Veneer Plaster: ASTM C587, with separate formulations; one for base-coat application and one for finish-coat application over substrates.

1. Base Coat:

2. Smooth Finish Coat:

3. Textured Finish Coat:

D. High-Strength, Two-Component Gypsum Veneer Plaster: ASTM C587, ready-mixed, base-coat plaster and smooth finish-coat veneer plaster containing mill-mixed, fine silica sand; with a compressive strength of 3000 psi (20 MPa) when tested according to ASTM C472.

1. Base Coat:

2. Smooth Finish Coat:

2.3 PANEL PRODUCTS

A. Gypsum Base for Veneer Plaster: ASTM C1396/C1396M.
1. Thickness: 1/2 inch (12.7 mm) or as directed.

B. Gypsum Base for Veneer Plaster, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm) or 3/4 inch (19.0 mm) or as directed.

C. Gypsum Base for Veneer Plaster, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.

1. Thickness: 1/2 inch (12.7 mm) and as directed.

D. Foil-Backed Gypsum Base for Veneer Plaster: ASTM C1396/C1396M.

1. Thickness: 1/2 inch (12.7 mm) and as directed.

E. Abuse-Resistant Gypsum Base for Veneer Plaster: With specially reinforced core for greater resistance to surface abrasion, indentation, soft-body impact, and hard-body impact.

1. Core: As directed.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
4. Abuse Resistance: ASTM C1629/C1629M, level as directed.

F. Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M. With moisture- and mold-resistant core; non-rated or fire-resistive rated, as directed; glass-mat facing on both sides of panel.

1. Core: As directed.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

G. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 and approved by backer unit manufacturer for use as veneer plaster substrate.

1. Thickness: 1/2 inch (12.7 mm), As directed.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

H. Backing Panels for Multilayer Applications: ASTM C1396/C1396M gypsum base or gypsum board, as recommended by gypsum veneer plaster manufacturer, for application method and thicknesses indicated.

1. Core: Matching face layer unless otherwise indicated.
2. Thickness: Matching face layer unless otherwise indicated.

2.4 TRIM ACCESSORIES

A. Standard Trim: ASTM C1047, approved for use in gypsum veneer plaster applications indicated.

1. Material: As directed.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

2.5 JOINT-REINFORCING MATERIALS

A. General: Comply with joint strength requirements in ASTM C587 and with gypsum veneer plaster manufacturer's written recommendations for each application indicated.

B. Joint Tape: As directed.

C. Embedding Material for Joint Tape: As recommended by gypsum veneer plaster manufacturer for use with joint-tape material and gypsum veneer plaster applications indicated.

2.6 AUXILIARY MATERIALS

A. Bonding Agent: ASTM C631 polyvinyl acetate.

B. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum-base, face-layer panels to backing-layer panels in multilayer construction.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

D. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

E. Sound Attenuation Blankets: ASTM C665, Type I; Comply with mineral-fiber requirements of assembly.

F. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, complying with ASTM C834.

G. Patching Mortar: Dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

PART 3 - EXECUTION

3.1 INSTALLING PANELS, GENERAL

A. Gypsum Base for Veneer Plaster: Apply according to ASTM C844 unless manufacturer's written recommendations are more stringent.

1. Erection Tolerance: No more than 1/16-inch (1.6-mm) offsets between planes of gypsum base panels, and 1/8 inch in 8 feet (3 mm in 2.4 m) noncumulative, for level, plumb, warp, and bow.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Install sound attenuation blankets before installing gypsum base for veneer plaster.

D. Cementitious Backer Units: Install according to ANSI A108.11.

1. Where cementitious backer units abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

E. Trim: Install trim with back flanges intended for fasteners and attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

F. Control Joints: Install as directed.

G. Gypsum Base: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

H. Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

I. Glass-Mat Interior Gypsum Board: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

3.2 GYPSUM VENEER PLASTERING

A. Bonding Agent: Apply bonding agent on dry “as directed” according to gypsum veneer plaster manufacturer's written recommendations.

B. Gypsum Veneer Plaster Mixing: Mechanically mix gypsum veneer plaster materials to comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

C. Gypsum Veneer Plaster Application: Comply with ASTM C843 and with veneer plaster manufacturer's written recommendations.

1. One-Component Gypsum Veneer Plaster: Trowel apply plaster over substrate to uniform thickness. Fill all voids and imperfections. Immediately double back with same mixer batch of plaster to a uniform total thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm).
2. Two-Component Gypsum Veneer Plaster:

    a. Base Coat: Hand trowel or machine apply base coat over substrate to a uniform thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm). Fill voids and imperfections.
    b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to a uniform thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm).

3. Where gypsum veneer plaster abuts metal, including doorframes, windows and other units, groove finish coat to eliminate spalling.
4. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations and directed.

D. Concealed Surfaces: Do not omit gypsum veneer plaster behind cabinets, furniture, furnishings, and similar removable items. Omit veneer plaster in the following areas where it will be concealed from view in the completed Work unless otherwise indicated or required to maintain fire-resistance and STC ratings:

1. Above suspended ceilings.
2. Behind wood paneling.

E. Gypsum Veneer Plaster Finish: As directed.

END OF SECTION 092613

SECTION 092713 - GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes factory-fabricated, glass-fiber-reinforced gypsum fabrications for interior applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C1467/C1467M.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED GYPSUM FABRICATIONS

A. Fabrications: Molded, glass-fiber-reinforced gypsum units complying with ASTM C1381/C1381M.

B. Embedments: As directed.

C. Finish: Smooth for paint finish or smooth for gloss paint finish or as directed.

2.2 AUXILIARY MATERIALS

A. Adhesives: As recommended in glass-fiber-reinforced gypsum fabrication manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002, unless otherwise indicated.

1. Screws complying with ASTM C954 for fastening glass-fiber-reinforced gypsum fabrications to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Joint-Treatment Materials: ASTM C475/C475M.

2.3 FABRICATION

A. Fabricate glass-fiber-reinforced gypsum units in factory to comply with ASTM C1381/C1381M, with smooth-finished surfaces; repair hollows, voids, scratches, and other surface imperfections. Fabricate units in lengths and sizes that will minimize number of joints between abutting units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASTM C1467/C1467M.

B. Install glass-fiber-reinforced gypsum fabrications level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment.

C. Attach glass-fiber-reinforced gypsum fabrications to framing and substrates with steel drill screws unless otherwise indicated. Do not use pneumatic staple guns. Countersink screw heads below adjoining finished surface.

D. Use joint-treatment materials to finish glass-fiber-reinforced gypsum fabrications to produce surfaces ready to receive primers and paint finishes.

END OF SECTION 092713

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Thickness: 1/2 inch (12.7 mm).

2. Long Edges: Tapered or Tapered and featured (rounded or beveled) for prefilling as directed.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered or Tapered and featured (rounded or beveled) for prefilling as directed.

C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch (6.4 mm).
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

E. Foil-Backed Gypsum Board: ASTM C1396/C1396M.

1. Core: As directed.
2. Long Edges: Tapered or Tapered and featured (rounded or beveled) for prefilling as directed.

F. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: As directed.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds requirements as directed.
3. Indentation: ASTM C1629/C1629M, meets or exceeds requirements as directed.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds requirements as directed.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

G. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: As directed.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds requirements as directed.
3. Indentation: ASTM C1629/C1629M, meets or exceeds requirements as directed.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds requirements as directed.
5. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds requirements as directed.
6. Long Edges: Tapered.

7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

H. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: As directed.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.

1. Core: As directed.

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Core: As directed.

2.6 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Core: As directed.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
1. Thickness: As directed.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: As directed.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose as directed compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping, drying-type, all-purpose compound as directed.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound as directed.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound, drying-type, all-purpose compound, high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish as directed.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

2.10 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E84.
1. Texture: As directed.

C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
   1. Texture: Light spatter or Spatter knock-down as directed.

D. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.

   1. Texture: As directed.

E. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.

   1. Application Thickness: 1/2 inch (12.7 mm) as directed.
   2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

      a. Flame-Spread Index: 25 as directed or less.
      b. Smoke-Developed Index: 50, 450 as directed or less.

   3. NRC: 0.55 according to ASTM C423.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are substrate for tile, Panels that are substrate for acoustical tile, as directed.
3. Level 3: As directed.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated as directed.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: As directed.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Quarry tile.
3. Pressed floor tile.
4. Porcelain tile.
5. Glazed wall tile.
6. Stone thresholds.
7. Tile backing panels.
8. Waterproof membrane for thinset applications.
9. Crack isolation membrane.
10. Metal edge strips.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples:

1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
3. Stone thresholds.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Ceramic Tile Type : Factory-mounted unglazed or glazed as directed ceramic mosaic tile.

1. Composition: As directed.
2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: As directed
4. Thickness: 1/4 inch (6.4 mm).
5. Face: Plain or Pattern of design indicated, with cushion edges.
6. Surface: Smooth (without) or Slip resistant (with) abrasive admixture or as directed.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Finish: As directed.
9. Tile Color and Pattern: As directed.
10. Grout Color: As directed.

11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cove: Cove, module size as directed.
    b. Base Cap: Bead (bullnose) or Surface bullnose, module size as directed.
    c. Wainscot Cap: Bead (bullnose) or Surface bullnose, module size as directed.
    d. External Corners for Thinset Mortar Installations: Bead (bullnose) or Surface bullnose, module size as directed.
    e. Internal Corners: Cove, module size as directed.
    f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.4 mm) across nominal 4-inch (100-mm) dimension.

B. Ceramic Tile Type : Unglazed or Glazed square-edged quarry tile.

1. Face Size: As directed.
2. Thickness: As directed
3. Wearing Surface: Nonabrasive, smooth or Abrasive aggregate embedded in surface, as directed.
4. Dynamic Coefficient of Friction: Not less than 0.42.
5. Finish: As directed.
6. Tile Color and Pattern: As directed.
7. Grout Color: As directed.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base: Coved with surface bullnose top edge, face size as directed.
    b. Wainscot Cap: Surface bullnose, face size as directed.

C. Ceramic Tile Type: Unglazed or Glazed as directed pressed floor tile.

1. Composition: As directed.
2. Face Size: As directed.
3. Face Size Variation: As directed.
4. Thickness: As directed.
5. Face: As directed.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Glaze: As directed.
8. Tile Color and Pattern: As directed.
9. Grout Color: As directed.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cove: Cove, module size same as adjoining flat tile.

b. Base Cap: Bead (bullnose) or Surface bullnose, module size same as adjoining flat tile.
c. Wainscot Cap: Bead (bullnose) or Surface bullnose, module size same as adjoining flat tile.
d. External Corners: Bead (bullnose) or Surface bullnose, module size same as adjoining flat tile.
e. Internal Corners: Cove, module size same as adjoining flat tile.
f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.4 mm) across nominal 4-inch (100-mm) dimension.

D. Ceramic Tile Type: Unglazed or Glazed porcelain tile as directed.

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Face Size: As directed.
3. Face Size Variation: Rectified.
4. Thickness: As directed.
5. Face: As directed.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color, Glaze, and Pattern: As directed.
8. Grout Color: As directed.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose, module size same as adjoining flat tile.
    b. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile.
    c. External Corners: Surface bullnose, module size same as adjoining flat tile.
    d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.4 mm) across nominal 4-inch (100-mm) dimension.

E. Ceramic Tile Type: Glazed wall tile.

1. Module Size: As directed.
2. Face Size Variation: Rectified.
3. Thickness: 5/16 inch (8 mm).
4. Face: As directed.
5. Finish: As directed.
6. Tile Color and Pattern: As directed.
7. Grout Color: As directed.
8. Mounting: Factory, back mounted.
9. Mounting: Pregrouted sheets of tiles are factory assembled and grouted with manufacturer's standard white silicone rubber.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

a. Base: Coved or Straight, module size, as directed.
b. Wainscot Cap: Bullnose cap or Surface bullnose, module size as directed.
c. External Corners: Bullnose or Surface bullnose, same size as adjoining flat tile.
d. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

F. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as used for adjoining wall tile.

1. One soap holder with grab handle for each shower and tub indicated.
2. One paper holder at each water closet.
3. Color and Finish: Match adjoining glazed wall tile as directed.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 or 12 as directed according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.
2. Description: Match Architect's sample.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.
1. Thickness: As directed.

B. Fiber-Cement Backer Board: ASTM C1288.

1. Thickness: 1/4 inch (6.4 mm) or 1/2 inch (12.7 mm) or as directed..

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Nominal Thickness: 0.030 inch (0.76 mm).
2. Nominal Thickness: 0.040 inch (1 mm).

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.

1. Nominal Thickness: 0.025 inch (0.6 mm).
2. Nominal Thickness: 0.040 inch (1 mm).

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.2-mm) nominal thickness.

E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1 -mm) nominal thickness.

F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

H. Latex-Portland Cement Waterproof Mortar: Flexible, waterproof mortar consisting of cement-based mix and latex additive.

I. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance or high performance as directed and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch (1-mm) nominal thickness.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.2-mm) nominal thickness.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch (4-mm) nominal thickness.

F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1mm) nominal thickness.

G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

I. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

J. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide nonsagging mortar.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

E. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thinset): ANSI A118.11.

1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.

F. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

G. Organic Adhesive: ANSI A136.1, Type I.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.

1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
2. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

E. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; as directed, ASTM A666, 300 Series exposed-edge material.

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior tile floors.
    b. Tile floors in wet areas.
    c. Tile swimming pool decks.
    d. Tile floors in laundries.
    e. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
    f. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: As directed.
2. Quarry Tile: As directed.

3. Pressed Floor Tile: As directed.
4. Glazed Wall Tile: As directed.
5. Porcelain Tile: As directed.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set or improved modified dry-set mortar (thinset) as directed.
2. Do not extend cleavage membrane waterproofing or crack isolation membrane under thresholds set in mortar as directed. Fill joints between such thresholds and adjoining tile set as directed with elastomeric sealant.

K. Metal Edge Strips: Install as directed.

L. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

M. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

N. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

O. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 EXTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Exterior Floor Installations:

1. Ceramic Tile Installation: TCNA F101 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) as directed.

a. Ceramic Tile Type: As directed.
b. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

2. Ceramic Tile Installation: TCNA F102; thinset mortar as directed.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

B. Exterior Roof/Deck Floor Installations:

1. Ceramic Tile Installation: TCNA F103 or TCNA F103B and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) over drainage material on roof membrane.

a. Ceramic Tile Type: As directed.
b. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

2. Ceramic Tile Installation : TCNA F104; thinset mortar As directed.

a. Ceramic Tile Type: As requested.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

C. Exterior Wall Installations, Masonry or Concrete:

1. Ceramic Tile Installation: TCNA W201 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) on metal lath over vapor-retarder membrane.

a. Ceramic Tile Type: As directed.
b. Bond Coat for Wet-Set Method: mortar, As directed.
c. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set mortar.
d. Grout: As directed.

2. Ceramic Tile Installation: TCNA W202; thinset mortar over waterproof membrane.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

D. Exterior Wall Installations, Wood or Metal Studs:

1. Ceramic Tile Installation: TCNA W244E; thinset mortar over waterproof membrane on cementitious backer units or on cementitious backer units over vapor-retarder membrane.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: As directed.

3.5 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F111 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: As directed.

2. Ceramic Tile Installation: TCNA F112 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) bonded to concrete.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: As directed.

3. Ceramic Tile Installation: TCNA F113; thinset mortar.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

4. Ceramic Tile Installation: TCNA F114 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane; epoxy grout.

    a. Ceramic Tile Type: As required
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: Water-cleanable epoxy grout.

5. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: Water-cleanable epoxy grout.

6. Ceramic Tile Installation: TCNA F116; As directed.

    a. Ceramic Tile Type: As directed.
    b. Grout: As directed.

7. Ceramic Tile Installation: TCNA F121 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) on waterproof membrane.

    a. Ceramic Tile Type: .
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: As directed.

8. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: High-performance sanded or unsanded grout.

9. Ceramic Tile Installation: TCNA F125-Full or TCNA F125-Full, except where partial coverage is indicated TCNA F125-Partial; thinset mortar on crack isolation membrane.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    c. Grout: As directed.

10. Ceramic Tile Installation : TCNA F131; water-cleanable, tile-setting epoxy; epoxy grout.

    a. Ceramic Tile Type: As directed.
    b. Grout: Water-cleanable epoxy grout.

11. Ceramic Tile Installation As directed: TCNA F132; water-cleanable, tile-setting epoxy on cured cement mortar bed bonded to concrete subfloor or installed over cleavage membrane; epoxy grout.

    a. Ceramic Tile Type: As directed.
    b. Grout: Water-cleanable epoxy grout.

B. Interior Floor Installations, Wood Subfloor:

1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) on waterproof membrane.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: As directed.

2. Ceramic Tile Installation: TCNA F141 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: As directed.
    c. Grout: As directed.

3. Ceramic Tile Installation: TCNA F142; organic adhesive.

    a. Ceramic Tile Type: As directed.
    b. Grout: As directed.

4. Ceramic Tile Installation: TCNA F143; water-cleanable, tile-setting epoxy; epoxy grout.

    a. Ceramic Tile Type: As directed.
    b. Grout: Water-cleanable epoxy grout.

5. Ceramic Tile Installation: TCNA F144; thinset mortar or water-cleanable epoxy adhesive on waterproof membrane over cementitious backer units or fiber-cement backer board.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

6. Ceramic Tile Installation: TCNA F150 or TCNA F160; thinset mortar on exterior-glue plywood.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: EGP (exterior glue plywood) latex-portland cement mortar.
    c. Grout: As directed.

C. Interior Radiant Heat Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA RH110; thinset mortar on crack isolation membrane; hydronic piping installed in concrete.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    c. Grout: As directed.

2. Ceramic Tile Installation: TCNA RH117 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) with hydronic piping installed in mortar bed.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set.
    c. Grout: As directed.

3. Ceramic Tile Installation: TCNA RH112; thinset mortar on crack isolation membrane; hydronic piping encapsulated in cementitious self-leveling underlayment.

    a. Ceramic Tile Type: As directed.
    b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    c. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    d. Grout: As directed.

4. Ceramic Tile Installation: TCNA RH115; thinset mortar; electric radiant system encapsulated in thinset mortar.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    c. Grout: As directed.

5. Ceramic Tile Installation: TCNA RH116; thinset mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment.

    a. Ceramic Tile Type: As directed.
    b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    c. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    d. Grout: As directed.

D. Interior Radiant Heat Floor Installations, Wood Subfloor:

1. Ceramic Tile Installation: TCNA RH123; thinset mortar on crack isolation membrane; hydronic piping encapsulated in cementitious self-leveling underlayment.

    a. Ceramic Tile Type: As directed.
    b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    c. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    d. Grout: As directed.

2. Ceramic Tile Installation: TCNA RH130; thinset mortar on exterior-glue plywood; electric radiant system encapsulated in thinset mortar.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: EGP (exterior glue plywood) latex-portland cement mortar.
    c. Grout: As directed.

3. Ceramic Tile Installation: TCNA RH135; thinset mortar on cementitious backer units or fiber-cement backer board; electric radiant system encapsulated in thinset mortar.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

4. Ceramic Tile Installation: TCNA RH140; thinset mortar on crack isolation membrane; electric radiant system encapsulated in cementitious self-leveling underlayment.

    a. Ceramic Tile Type: As directed.
    b. Cementitious Self-Leveling Underlayment: Specified in Section 035416 "Hydraulic Cement Underlayment."
    c. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    d. Grout: As directed.

5. Ceramic Tile Installation: TCNA RH141 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) with hydronic piping installed in mortar bed.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set mortar.
    c. Grout: As directed.

E. Interior Wall Installations, Masonry or Concrete:

1. Ceramic Tile Installation: TCNA W202; thinset mortar.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

2. Ceramic Tile Installation: TCNA W211 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) bonded to substrate.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

3. Ceramic Tile Installation: TCNA W221 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

4. Ceramic Tile Installation: TCNA W222 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; one-coat cement mortar bed (thickset) on metal lath over cleavage membrane over waterproof membrane.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

5. Ceramic Tile Installation: TCNA W223; organic adhesive.

    a. Ceramic Tile Type: As directed.
    b. Grout: As directed.

F. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W221 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

2. Ceramic Tile Installation: TCNA W222 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; one-coat cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

3. Ceramic Tile Installation: TCNA W223; organic adhesive on solid backing.

    a. Ceramic Tile Type: As directed.
    b. Grout: As directed.

4. Ceramic Tile Installation: TCNA W231/W241 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset).

    a. Ceramic Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: As directed.
    c. Bond Coat for Cured-Bed Method: As directed.
    d. Grout: As directed.

5. Ceramic Tile Installation: TCNA W242; organic adhesive on gypsum board.

    a. Ceramic Tile Type: As directed.
    b. Grout: As directed.

6. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

7. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

8. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

G. Bathtub Wall Installations with No Shower Head, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA B413; thinset mortar or organic adhesive on water-resistant gypsum board.

    a. Ceramic Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

H. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation TCNA B411 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) over vapor-retarder membrane.

a. Ceramic Tile Type: As directed.
b. Bond Coat for Wet-Set Method: As directed.
c. Bond Coat for Cured-Bed Method: As directed.
d. Grout: As directed.

2. Ceramic Tile Installation: TCNA B412; on cementitious backer units or fiber-cement backer board as directed.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

3. Ceramic Tile Installation: TCNA B419; thinset mortar on coated glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

I. Shower Receptor and Wall Installations:

1. Ceramic Tile Installation: TCNA B414 and ANSI A108.1A, ANSI A108.1B, ANSI A108.1C; cement mortar bed (thickset) over vapor-retarder membrane.

a. Ceramic Tile Type: As directed.
b. Bond Coat for Wet-Set Method: As directed.
c. Bond Coat for Cured-Bed Method: As directed.
d. Grout: As directed.

2. Ceramic Tile Installation: TCNA B415; As directed.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

3. Ceramic Tile Installation: TCNA B420; thinset mortar as directed.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

4. Ceramic Tile Installation: TCNA B421; thinset mortar on waterproof membrane over solid backing.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
c. Grout: As directed.

5. Ceramic Tile Installation: TCNA B422; thinset mortar on waterproof membrane with integrated bonding flange for bonded membranes.

a. Ceramic Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

END OF SECTION 093013

SECTION 093023 - GLASS MOSAIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass tile.
2. Tile backing panels.
3. Waterproof membrane for thinset applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

C. Sustainable Design Submittals:

D. Samples:

1. Each type and composition of tile and for each color and finish required. For glass mosaic tile in color blend patterns, provide samples of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of glass tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Glass Tile Standard: Provide Standard grade glass tile that complies with ANSI A137.2 for types and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Glass Tile Type: Large format glass tile, as directed.

1. Face Size: As directed.
2. Sizing Category: Standard or Natural.
3. Tile Color and Pattern: As directed.
4. Grout Color: As directed.

B. Glass Tile Type: Factory-mounted mosaic glass tile, as directed.

1. Module Size: As directed.
2. Sizing Category: Standard or Natural.
3. Tile Color and Pattern: As directed.
4. Grout Color: As directed.

C. Glass Tile Type: Factory-mounted miniature mosaic glass tile, as directed.

1. Module Size: As directed.

2. Sizing Category: Standard or Natural.
3. Tile Color and Pattern: As directed.
4. Grout Color: As directed.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.

1. Thickness: As directed.

B. Fiber-Cement Backer Board: ASTM C1288.
1. Thickness: 1/4 inch (6.4 mm) or 1/2 inch (12.7 mm) or as directed.

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Nominal Thickness: 0.030 inch (0.76 mm).
2. Nominal Thickness: 0.040 inch (1 mm).

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.

1. Nominal Thickness: 0.025 inch (0.6 mm).
2. Nominal Thickness: 0.040 inch (1 mm).

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.

E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1-mm) nominal thickness.

F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

H. Latex-Portland Cement Waterproof Mortar: Flexible, waterproof mortar consisting of cement-based mix and latex additive.

I. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.5 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02; use white cement unless otherwise indicated.

B. Standard Dry-Set Mortar (Thinset): ANSI A118; white, unless otherwise indicated.

1. For wall applications, provide nonsagging mortar.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4; white, unless otherwise indicated.

1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15; white, unless otherwise indicated.

1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

E. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

F. Organic Adhesive: ANSI A136.1, Type I.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.
1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
2. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness; As directed.

C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 GLASS TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for

straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Large Format Glass Tile: 1/16 inch (1.6 mm) or 1/8 inch (3.2 mm).
2. Mosaic Glass Tile: 1/16 inch (1.6 mm) or 1/8 inch (3.2 mm).
3. Miniature Mosaic Glass Tile: 1/16 inch (1.6 mm) or 1/8 inch (3.2 mm).

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

I. Metal Edge Strips: Install at locations indicated.

J. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

K. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated (As directed). Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

3.4 EXTERIOR GLASS TILE INSTALLATION SCHEDULE

A. Exterior Wall Installations, Masonry or Concrete:

1. Glass Tile Installation: TCNA W201 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset) on metal lath over vapor-retarder membrane.

a. Glass Tile Type: As directed.
b. Bond Coat: As directed.
c. Grout: As directed.

2. Glass Tile Installation: TCNA W202; thinset mortar over waterproof membrane.

a. Glass Tile Type: As directed.

b. Thinset Mortar: As directed.
c. Grout: As directed.

3.5 INTERIOR GLASS TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Masonry or Concrete:

1. Glass Tile Installation : TCNA W202; thinset mortar.

   a. Glass Tile Type: As directed.
   b. Thinset Mortar: As directed.
   c. Grout: As directed.

2. Glass Tile Installation: TCNA W211 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset) bonded to substrate.

   a. Glass Tile Type: As directed.
   b. Bond Coat: As directed.
   c. Grout: As directed.

3. Glass Tile Installation: TCNA W221 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane.

   a. Glass Tile Type: As directed.
   b. Bond Coat: As directed.
   c. Grout: As directed.

4. Glass Tile Installation: TCNA W222 and ANSI A108.1, ANSI A108.15, ANSI A108.16; one-coat cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane.

   a. Glass Tile Type: As directed.
   b. Bond Coat: As directed.
   c. Grout: As directed.

5. Glass Tile Installation: TCNA W223; organic adhesive.

   a. Glass Tile Type: As directed.
   b. Grout: As directed.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Glass Tile Installation: TCNA W221 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

   a. Glass Tile Type: As directed.
   b. Bond Coat: As directed.
   c. Grout: As directed.

2. Glass Tile Installation: TCNA W222 and ANSI A108.14, ANSI A108.15, ANSI A108.16; one-coat cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

    a. Glass Tile Type: As directed.
    b. Bond Coat: As directed.
    c. Grout: As directed.

3. Glass Tile Installation: TCNA W223; organic adhesive on solid backing.

    a. Glass Tile Type: As directed.
    b. Grout: As directed.

4. Glass Tile Installation: TCNA W231/W241 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset).

    a. Glass Tile Type: As directed.
    b. Bond Coat: As directed.
    c. Grout: As directed.

5. Glass Tile Installation: TCNA W242; organic adhesive on gypsum board.

    a. Glass Tile Type: As directed.
    b. Grout: As directed.

6. Glass Tile Installation: TCNA W243; thinset mortar on gypsum board.

    a. Glass Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

7. Glass Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.

    a. Glass Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

8. Glass Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

    a. Glass Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

C. Bathtub Wall Installations with No Shower Head, Wood or Metal Studs or Furring:

1. Glass Tile Installation: TCNA B413; thinset mortar or organic adhesive on water-resistant gypsum board.

    a. Glass Tile Type: As directed.
    b. Thinset Mortar: As directed.

c. Grout: As directed.

D. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Glass Tile Installation: TCNA B411 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset) over vapor-retarder membrane.

a. Glass Tile Type: As directed.
b. Bond Coat: As directed.
c. Grout: As directed.

2. Glass Tile Installation: TCNA B412; On cementitious backer units or fiber-cement backer board, as directed.

a. Glass Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

3. Glass Tile Installation: TCNA B419; thinset mortar or organic adhesive on coated glass-mat, water-resistant gypsum backer board.

a. Glass Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

E. Shower Receptor and Wall Installations:

1. Glass Tile Installation: TCNA B414 and ANSI A108.14, ANSI A108.15, ANSI A108.16; cement mortar bed (thickset).

a. Glass Tile Type: As directed.
b. Bond Coat: As directed.
c. Grout: As directed.

2. Glass Tile Installation: TCNA B415; As directed.

a. Glass Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

3. Glass Tile Installation: TCNA B420; thinset mortar as directed.

a. Glass Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

4. Glass Tile Installation: TCNA B421; thinset mortar on waterproof membrane over solid backing.

a. Glass Tile Type: As directed.
b. Thinset Mortar: As directed.
c. Grout: As directed.

5. Glass Tile Installation: TCNA B422; thinset mortar on waterproof membrane with integrated bonding flange for bonded membranes.

    a. Glass Tile Type: As directed.
    b. Thinset Mortar: As directed.
    c. Grout: As directed.

END OF SECTION 093023

SECTION 093033 - STONE TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimension stone tile.
2. Tile backing panels.
3. Waterproof membrane for thinset applications.
4. Crack isolation membrane.
5. Metal edge strips.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples:

1. Full-size units of each type of stone tile in each finish required.
2. Assembled Samples with grouted joints for each type of stone tile and for each finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For dimension stone tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Dimension Stone Tile: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of stone floor tile installation.
2. Build mockup of each type of stone wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 STONE PRODUCTS

A. Varieties and Sources: Subject to compliance with requirements, provide those indicated, provide one of those indicated or stone products that may be incorporated into the Work include, but are not limited to, those indicated.

B. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than 8, 10, 12 or 25 according to ASTM C1353 or ASTM C241/C241M or as directed.

C. Stone Tile Type ST-#:

1. Stone Type: Granite, complying with ASTM C615/C615M.
2. Stone Type: Limestone, complying with ASTM C568/C568M, Classification II (Medium Density) or III (High Density) as directed.
3. Stone Type: Marble, complying with ASTM C503/C503M, Classification I, Calcite or II, Dolomite as directed.
4. Stone Type: Quartz-based stone, complying with ASTM C616/C616M, Classification II, Quartzitic Sandstone or III, Quartzite as directed.
5. Stone Type: Serpentine, complying with ASTM C1526, Classification I, Exterior or II, Interior as directed.
6. Stone Type: Slate, complying with ASTM C629/C629M, Classification I, Exterior or II, Interior as directed.
7. Stone Type: Travertine, complying with ASTM C1527/C1527M, Classification I, Exterior or II, Interior as directed.
8. Varieties and Sources:

9. Cut: Vein or Fleuri as directed.
10. Finish: Polished, Honed, Sand rubbed, Thermal, Natural cleft, As indicated or Match Architect's sample.
11. Edges: Square, Beveled or Eased as directed.
12. Module Size: 6 by 6 inches (152 by 152 mm), 6 by 12 inches (152 by 305 mm), 12 by 12 inches (305 by 305 mm), 300 by 300 mm, 18 by 18 inches (457 by 457 mm), 500 by 500 mm or As indicated.
13. Nominal Tile Thickness: 1/4 inch (6 mm), 3/8 inch (10 mm), 1/2 inch (13 mm) or 5/8 inch (16 mm) as directed.
14. Joint Width: Hand tight, 1/16 inch (1.5 mm), 1/8 inch (3 mm), 1/4 inch (6 mm), 3/8 inch (10 mm) or 1/2 inch (13 mm) as directed.

2.2 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.
   1. Thickness: 1/4 inch (6.4 mm), 1/2 inch (12.7 mm), 5/8 inch (15.9 mm) or As indicated.

B. Fiber-Cement Backer Board: ASTM C1288.
   1. Thickness: 1/4 inch (6.4 mm), 1/2 inch (12.7 mm) or As indicated.

2.3 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.
   1. Nominal Thickness: 0.030 inch (0.76 mm).
   2. Nominal Thickness: 0.040 inch (1 mm).

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester.
   1. Nominal Thickness: 0.025 inch (0.6 mm).
   2. Nominal Thickness: 0.040 inch (1 mm).

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.

E. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with woven reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.

F. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

G. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

H. Latex-Portland Cement Waterproof Mortar: Flexible, waterproof mortar consisting of cement-based mix and latex additive.

I. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.

2.4 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance or high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch (1-mm) nominal thickness.

D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.203-mm) nominal thickness.

E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 1/8-inch (3-mm) nominal thickness.

F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1.01-mm) nominal thickness.

G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

I. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

J. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

2.5 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide nonsagging mortar.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

E. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

F. Organic Adhesive: ANSI A136.1, Type I.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.
   1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
   2. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match stone tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; half-hard brass, white zinc alloy, nickel silver or stainless-steel, ASTM A666, 300 Series exposed-edge material as directed.

C. Floor Sealer: Colorless, stain- and slip-resistant sealer, not affecting color or physical properties of stone surfaces as recommended by stone tile producers for application indicated.

2.8 FABRICATION

A. Facial Dimensions of Stone Tiles with Polished or Honed Faces: Do not vary facial dimensions from specified dimensions by more than plus or minus 1/64 inch (0.4 mm).

B. Facial Dimensions of Stone Tiles with Sand-Rubbed, Natural-Cleft, or Thermal-Finished Faces as directed: Do not vary facial dimensions from specified dimensions by more than plus or minus 1/32 inch (0.8 mm).

C. Thickness of Stone Tiles with Polished, Honed or Sand-Rubbed Finish as directed: Do not vary from specified thickness by more than plus or minus 1/32 inch (0.8 mm).

D. Thickness of Stone Tiles with Natural-Cleft or Thermal Finish: Do not vary average thickness of each stone tile from specified thickness by more than plus or minus 1/32 inch (0.8 mm) or 1/16 inch (1.5 mm) as directed.

E. Backs of Tiles: Gage units by dressing backs of tiles smooth and flat. When tested with a 24-inch (600-mm) straightedge, gap shall not exceed 1/32 inch (0.8 mm).

   1. Natural-cleft stone need not be gaged if gap does not exceed 1/16 inch (1.5 mm) when tested with a 24-inch (610-mm) straightedge on backs of units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where stone tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting stone tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for stone tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated as directed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for stone tile floors installed with adhesives or thinset mortar with trowelable patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

3.3 STONE TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in stone tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods specified in stone tile installation schedules and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior stone tile floors.
    b. Stone tile floors in wet areas.
    c. Stone tile floors consisting of stone tiles 8 by 8 inches (200 by 200 mm) or larger.

B. Extend stone tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of stone tile without marring visible surfaces. Carefully grind cut edges of stone tile abutting trim, finish, or built-in

items for straight aligned joints. Fit stone tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap stone tile.

D. Finish cut stone tile edges that will not be concealed by other construction by grinding and honing cut surfaces and beveling edges and easing edges to match factory-fabricated edges unless otherwise indicated.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay stone tile in grid pattern unless otherwise indicated. Lay out stone tile work and center stone tile fields in both directions in each space or on each wall area. Lay out stone tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Match stone tiles within each space by selecting tiles to achieve uniformity of color and pattern. Reject or relocate stone tiles that do not match color and pattern of adjacent tiles.

H. Mix stone tiles to achieve a uniformly random distribution of color shadings and patterns.

I. Pattern Orientation: For stone varieties with directional pattern, orient pattern as indicated or directed by Architect.

J. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and stone tile. Do not saw-cut joints after installing stone tiles.

1. Where joints occur in concrete substrates, locate joints in stone tile surfaces directly above them.

K. Metal Edge Strips: Install at locations indicated, where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with top of stone tile or where exposed edge of stone tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of stone tile and no threshold is indicated.

3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

3.7 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical joints, external corners, and other conspicuous lines, do not exceed 1/8 inch in 8 ft. (3 mm in 2.4 m).

B. Variation in Level: For horizontal joints and other conspicuous lines, do not exceed 1/8 inch in 10 ft. (3 mm in 3 m), or 1/2 inch (12 mm).

C. Variation in Surface Plane of Flooring: Do not exceed 1/8 inch in 10 ft. (3 mm in 3 m) from level or slope indicated when tested with a 10-ft. (3-m) straightedge.

D. Variation in Plane between Adjacent Units (Lipping): Do not exceed the following differences between faces of adjacent units as measured from a straightedge parallel to stone tiled surface:

1. Units with Polished Faces: 1/64 inch (0.4 mm).
2. Units with Honed Faces: 1/64 inch (0.4 mm) or 1/32 inch (0.8 mm) as directed.
3. Units with Sand-Rubbed Faces: 1/32 inch (0.8 mm).
4. Units with Thermal-Finished Faces: Depth of thermal finish or 3/16 inch (5 mm), whichever is less.
5. Units with Natural-Cleft Faces: Depth of natural-cleft finish or 3/16 inch (5 mm), whichever is less.

E. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch (1.6 mm) or one-fourth of nominal joint width, whichever is less.

F. Hand-Tight Joints: Do not exceed 1/64 inch (0.4 mm) or 1/32 inch (0.8 mm) as directed.

3.8 CLEANING AND PROTECTION

A. Cleaning: On completion of placement and grouting, clean stone tile surfaces so they are free of foreign matter.

B. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

3.9 EXTERIOR STONE TILE INSTALLATION SCHEDULE

A. Exterior Floor Installations:

1. Stone Tile Installation: TCNA F101 STONE and ANSI A108.1A, ANSI A108.1BANSI A108.1C; cement mortar bed (thickset) bonded to concrete, over waterproof membrane on concrete or over waterproof membrane on concrete where indicated and bonded to concrete where membrane is not indicated.

a. Stone Tile Type: As directed.
b. Bond Coat for Cured-Bed Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

2. Stone Tile Installation: TCNA F102 STONE; thinset mortar on concrete, over waterproof membrane on concrete or over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated.

a. Stone Tile Type: As directed.
b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

B. Exterior Roof/Deck Floor Installations:

1. Stone Tile Installation: TCNA F103 STONE or TCNA F103B STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) over drainage material on roof membrane.

a. Stone Tile Type: As directed.
b. Bond Coat for Cured-Bed Method: Modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

2. Stone Tile Installation: TCNA F104 STONE; thinset mortar on concrete, over waterproof membrane on concrete or over waterproof membrane on concrete where indicated and on concrete where membrane is not indicated.

a. Stone Tile Type: As directed.
b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

C. Exterior Wall Installations, Masonry or Concrete:

1. Stone Tile Installation: TCNA W201 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) on metal lath over vapor-retarder membrane.

a. Stone Tile Type: As directed.
b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Bond Coat for Cured-Bed Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

2. Stone Tile Installation: TCNA W202 STONE; thinset mortar over waterproof membrane.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

D. Exterior Wall Installations, Wood or Metal Studs:

1. Stone Tile Installation: TCNA W244E STONE; thinset mortar over waterproof membrane on cementitious backer units or on cementitious backer units over vapor-retarder membrane.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

3.10 INTERIOR STONE TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Stone Tile Installation: TCNA F111 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) with cleavage membrane.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

2. Stone Tile Installation: TCNA F112 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) bonded to concrete.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

3. Stone Tile Installation: TCNA F113 STONE; thinset mortar or water-cleanable, tile-setting epoxy as directed.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.

c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

4. Stone Tile Installation: TCNA F121 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) on waterproof membrane.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

5. Stone Tile Installation: TCNA F122 STONE; thinset mortar or water-cleanable, tile-setting epoxy on waterproof membrane as directed.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: High-performance sanded or unsanded grout as directed.

6. Stone Tile Installation: TCNA F125-Full STONE; thinset mortar on crack isolation membrane.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

B. Interior Floor Installations, Wood Subfloor:

1. Stone Tile Installation: TCNA F141 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane or waterproof membrane as directed.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

2. Stone Tile Installation: TCNA F250 STONE; thinset mortar, water-cleanable, tile-setting epoxy on waterproof membrane over cementitious backer units or fiber-cement backer board.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

C. Interior Radiant-Heat Floor Installations, Concrete Subfloor:

1. Stone Tile Installation: TCNA RH110 STONE; thinset mortar, water-cleanable, tile-setting epoxy on crack isolation membrane; hydronic piping installed in concrete.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

2. Stone Tile Installation: TCNA RH117 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) with hydronic piping installed in mortar bed.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

D. Interior Radiant-Heat Floor Installations, Wood Subfloor:

1. Stone Tile Installation: TCNA RH141 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) with hydronic piping installed in mortar bed with cleavage membrane or waterproof membrane.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

E. Interior Wall Installations, Masonry or Concrete:

1. Stone Tile Installation: TCNA W211 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) bonded to substrate.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
   c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

2. Stone Tile Installation: TCNA W221 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C, cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane as directed.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
    d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

3. Stone Tile Installation: TCNA W222 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; one-coat cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane as directed.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
    d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

F. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Stone Tile Installation: TCNA W221 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing as directed.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
    d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

2. Stone Tile Installation: TCNA W222 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; one-coat cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

    a. Stone Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.

d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

3. Stone Tile Installation: TCNA W231/W241 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane or waterproof membrane as directed.

   a. Stone Tile Type: As directed.
   b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
   c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
   d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

4. Stone Tile Installation: TCNA W243 STONE; thinset mortar or water-cleanable, tile-setting epoxy on gypsum board as directed.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

5. Stone Tile Installation: TCNA W244 STONE; thinset mortar or water-cleanable, tile-setting epoxy on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

6. Stone Tile Installation: TCNA W245 STONE; thinset mortar or water-cleanable, tile-setting epoxy on coated glass-mat, water-resistant gypsum backer board.

   a. Stone Tile Type: As directed.
   b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
   c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

G. Bathtub Wall Installations with no Shower Head, Wood or Metal Studs or Furring:

1. Stone Tile Installation: TCNA B413 STONE; thinset mortar or water-cleanable, tile-setting epoxy on water-resistant gypsum board as directed.

a. Stone Tile Type: As directed.
b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

H. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Stone Tile Installation: TCNA B411 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) over vapor-retarder membrane.

a. Stone Tile Type: As directed.
b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Bond Coat for Cured-Bed Method: Standard dry-set mortar, modified dry-set mortar, Improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout.

2. Stone Tile Installation: TCNA B412 STONE; thinset mortar or water-cleanable, tile-setting epoxy on cementitious backer units or fiber-cement backer board.

a. Stone Tile Type: As directed.
b. Thinset Mortar: Standard dry-set, Modified dry-set or Improved modified dry-set mortar as directed.
c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

3. Stone Tile Installation: TCNA B419 STONE; thinset mortar or water-cleanable, tile-setting epoxy on coated glass-mat, water-resistant gypsum backer board.

a. Stone Tile Type: As directed

I. Shower Receptor and Wall Installations:

1. Stone Tile Installation: TCNA B414 STONE and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C as directed; cement mortar bed (thickset) over vapor-retarder membrane.

a. Stone Tile Type: As directed.
b. Bond Coat for Wet-Set Method: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
c. Bond Coat for Cured-Bed Method: Modified dry-set mortar, improved modified dry-set mortar or Water-cleanable, tile-setting epoxy as directed.
d. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded or High-performance unsanded grout as directed.

2. Stone Tile Installation: TCNA B415 STONE; thinset mortar or water-cleanable, tile-setting epoxy on waterproof membrane over cementitious backer units or fiber-cement backer board or cementitious backer units or fiber-cement backer board over vapor-retarder membrane as directed

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

3. Stone Tile Installation: TCNA B420 STONE; thinset mortar or water-cleanable, tile-setting epoxy on waterproof membrane over coated glass-mat, water-resistant gypsum backer board or coated glass-mat, water-resistant gypsum backer board over vapor-retarder membrane as directed.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

4. Stone Tile Installation: TCNA B421 STONE; thinset mortar or water-cleanable, tile-setting epoxy on waterproof membrane over solid backing as directed.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

5. Stone Tile Installation: TCNA B422 STONE; thinset mortar or water-cleanable, tile-setting epoxy on waterproof membrane with integrated bonding flange for bonded membranes as directed.

    a. Stone Tile Type: As directed.
    b. Thinset Mortar: Standard dry-set, modified dry-set or Improved modified dry-set mortar as directed.
    c. Grout: Sand-portland cement, Standard sanded cement, Standard unsanded cement, High-performance sanded, High-performance unsanded or Water-cleanable epoxy grout as directed.

END OF SECTION 093033

SECTION 093500 - CHEMICAL-RESISTANT TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chemical-resistant tile.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 CHEMICAL-RESISTANT TILE PRODUCTS

A. Chemical-Resistant Tile Type CRT-#: Unglazed square-edged quarry tile.
1. Face Size: 3 by 3 inches (76 by 76 mm), 4 by 4 inches (102 by 102 mm), 6 by 3 inches (152 by 76 mm), 6 by 6 inches (152 by 152 mm), 8 by 3-7/8 inches (200 by 98 mm) or 8 by 8 inches (200 by 200 mm) as directed.
2. Thickness: 3/8 inch (9.5 mm), 1/2 inch (12.7 mm) or 3/4 inch (19 mm) as directed.
3. Wearing Surface: Nonabrasive, smooth or Abrasive aggregate embedded in surface as directed.
4. Dynamic Coefficient of Friction: Not less than 0.42.
5. Tile Color and Pattern: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.
6. Grout Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.
7. Precoat with temporary protective coating.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base: Coved with surface bullnose top edge, face size 6 by 6 inches (152 by 152 mm) or 8 by 3-7/8 inches (200 by 98 mm) as directed.
    b. Wainscot Cap: Surface bullnose, face size 6 by 6 inches (152 by 152 mm) or 8 by 3-7/8 inches (200 by 98 mm) as directed.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.
1. Thickness: 1/4 inch (6.4 mm), 1/2 inch (12.7 mm), 5/8 inch (15.9 mm) or As indicated.

B. Fiber-Cement Backer Board: ASTM C1288.
1. Thickness: 1/4 inch (6.4 mm), 1/2 inch (12.7 mm) or As indicated.

2.4 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide nonsagging mortar.

C. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
3. For wall applications, provide nonsagging mortar.

D. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

E. Chemical-Resistant Furan Mortar: ANSI A118.5, with carbon filler.

2.5 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 F and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

B. Chemical-Resistant Furan Grout: ANSI A118.5, with carbon filler.

C. Chemical-Resistant Vinyl-Ester Resin Grout: ASTM C658.

2.6 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
   1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Chemical-Resistant Sealants: Provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable underlayments and patching compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) according to ASTM D87 and formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 CHEMICAL-RESISTANT TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with 1/4-inch (6.4-mm) or 3/8-inch (9.5-mm) joint width.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

H. Install cementitious backer units and fiber-cement backer board and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.5 CHEMICAL-RESISTANT TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete:

1. Chemical-Resistant Tile Installation: TCNA F114 and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane.

a. Chemical-Resistant Tile Type: As directed.
b. Bond Coat for Cured-Bed Method: Dry-set or Latex-portland cement mortar.
c. Grout: Water-cleanable epoxy, Chemical-resistant furan or Chemical-resistant vinyl-ester as directed.

2. Chemical-Resistant Tile Installation: TCNA F115; thinset mortar.

a. Chemical-Resistant Tile Type: As directed.
b. Thinset Mortar: Dry-set or Latex-portland cement mortar.
c. Grout: Water-cleanable epoxy, Chemical-resistant furan or Chemical-resistant vinyl-ester a directed.

3. Chemical-Resistant Tile Installation: TCNA F131; water-cleanable, tile-setting epoxy.

    a. Chemical-Resistant Tile Type: As directed.
    b. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester.

4. Chemical-Resistant Tile Installation: TCNA F132; Water-cleanable, tile-setting epoxy on cured cement mortar bed bonded to concrete subfloor or installed over cleavage membrane as directed.

    a. Chemical-Resistant Tile Type: As directed.
    b. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester.

5. Chemical-Resistant Tile Installation: TCNA F133 except use water-cleanable, tile-setting epoxy instead of furan mortar; furan grout.

    a. Chemical-Resistant Tile Type: As directed.
    b. Bond Coat: Chemical-resistant furan mortar or Water-cleanable, tile-setting epoxy as directed.
    c. Grout: Chemical-resistant furan grout.

B. Interior Wall Installations, Masonry or Concrete:

1. Chemical-Resistant Tile Installation: TCNA W202; thinset mortar.

    a. Chemical-Resistant Tile Type: As directed.
    b. Thinset Mortar: Dry-set or Latex-portland cement mortar as directed.
    c. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester.

2. Chemical-Resistant Tile Installation: TCNA W211 and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) bonded to substrate as directed.

    a. Chemical-Resistant Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Dry-set or Latex-portland cement mortar as directed.
    c. Bond Coat for Cured-Bed Method: Dry-set or Latex-portland cement mortar as directed.
    d. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester as directed.

3. Chemical-Resistant Tile Installation: TCNA W221 and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) on metal lath over cleavage membrane or over waterproof membrane as directed.

    a. Chemical-Resistant Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Dry-set or Latex-portland cement mortar as directed.
    c. Bond Coat for Cured-Bed Method: Dry-set or Latex-portland cement mortar as directed.
    d. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester as directed.

C. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Chemical-Resistant Tile Installation: TCNA W221 and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing.

    a. Chemical-Resistant Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Dry-set or Latex- portland cement mortar.
    c. Bond Coat for Cured-Bed Method: Dry-set or Latex-portland cement mortar.
    d. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester.

2. Chemical-Resistant Tile Installation: TCNA W222 and ANSI A108.1A, ANSI A108.1B or ANSI A108.1C; one-coat cement mortar bed (thickset) over cleavage membrane or over waterproof membrane on solid backing as directed.

    a. Chemical-Resistant Tile Type: As directed.
    b. Bond Coat for Wet-Set Method: Dry-set or Latex-portland cement mortar as directed.
    c. Bond Coat for Cured-Bed Method: Dry-set or Latex-portland cement mortar as directed.
    d. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester as directed.

3. Chemical-Resistant Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.

    a. Chemical-Resistant Tile Type: As directed.
    b. Thinset Mortar: Dry-set or Latex-portland cement mortar as directed.
    c. Grout: Water-cleanable epoxy or Chemical-resistant vinyl-ester as directed.

END OF SECTION 093500

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 as directed.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A, B or C according to ASTM E1264 and as directed.
2. Smoke-Developed Index: 50 or 450 as directed.

2.2 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E1264.

B. Classification: As directed.

C. Color: White or as directed.

D. Light Reflectance (LR): As directed.

E. Ceiling Attenuation Class (CAC): As directed

F. Noise Reduction Coefficient (NRC): As directed.

G. Articulation Class (AC): As directed.

H. Edge/Joint Detail: As directed.

I. Thickness: As directed.

J. Modular Size: As directed.

2.3 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate or Heavy-duty system.

2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Painted white or as directed.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate or Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush or Flanges formed with an integral center reveal.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Painted white or as directed.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Hold-Down Clips: Manufacturer's standard hold-down.

C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Arrange directionally patterned acoustical panels as follows:

    a. As indicated on reflected ceiling plans.
    b. Install panels with pattern running in one direction parallel to long or short axis of space.
    c. Install panels in a basket-weave pattern.

4. Install hold-down, impact and seismic clips (as directed) in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage or Engage a qualified special inspector to perform inspections.

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

END OF SECTION 095113

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

B. Related Requirements:

1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.
2. Section 095133 "Acoustical Metal Pan Ceilings" for ceilings consisting of metal-pan units with exposed and concealed suspension systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 as directed.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A, B or C according to ASTM E1264 as directed.
2. Smoke-Developed Index: 50 or 450, as directed or less.

2.2 ACOUSTICAL TILES

A. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.

B. Classification: As directed.

C. Color: White or as directed.

D. Light Reflectance (LR): As directed.

E. Ceiling Attenuation Class (CAC): As directed.

F. Noise Reduction Coefficient (NRC): As directed.

G. Articulation Class (AC): As directed.

H. Edge/Joint Detail: As directed.

I. Thickness: 5/8 inch (15 mm) or 3/4 inch (19 mm). as directed.

J. Modular Size: 12 by 12 inches (305 by 305 mm) or 300 by 300 mm as directed.

2.3 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C635/C635M.

B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

1. Structural Classification: Intermediate or Heavy-duty system.
2. Access: Upward or Downward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

a. Initial Access Opening: In each module, **24 by 24 inches (610 by 610 mm)**, as directed.

2.4 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage or Engage a qualified special inspector to perform inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

END OF SECTION 095123

SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical metal pans and associated suspension system for interior ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For design of seismic restraints and attachment devices.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints and attachment devices.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E1264 for Class A, Class B, Class C materials.
2. Smoke-Developed Index: As directed 50 or 450 or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

A. Acoustical Panel Standard: Comply with ASTM E1264.

B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Rolled aluminum sheet, complying with ASTM B209 (ASTM B209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C635/C635M.

    a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A879/A879M, 13Z (40G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
    b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A1008/A1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.

C. Sound-Absorbent Pads: Provide width and length to completely fill concealed surface of pan, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E84, and to comply with the following requirements:

1. Plastic Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C553, Type I, Type II, or Type III, and as follows:

    a. Mineral-Fiber Type and Thickness: Glass fiber; As directed.
    b. Mineral-Fiber Density: As directed.
    c. Plastic Sheet Thickness and Color: Not less than 0.003 inch (0.076 mm); As directed.

D. Adhesive: Manufacturer's standard nonflammable adhesive for sound-absorbent pads.

2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING

A. Classification: Units complying with ASTM E1264 for Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing or Type XX, other types described as unperforated aluminum facing (pan) units as directed.

1. Pattern: As directed.

B. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.

1. Lay-in Pans: Formed to set in exposed suspension grid.
2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.
4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.

C. Pan Thickness: As directed.

D. Pan Edge Detail: As directed.

E. Pan Size: As directed.

F. Pan Face Finish: As directed.

G. Light Reflectance Coefficient: As directed.

H. NRC: As directed.

I. Ceiling Attenuation Class: As directed.

2.4 STEEL PANS FOR ACOUSTICAL METAL PAN CEILING

A. Classification: Units complying with ASTM E1264 for Type V, perforated steel facing (pan) with mineral- or glass-fiber-base backing or Type XX, other types described as unperforated steel facing (pan) units.

1. Pattern: As directed.

B. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.

1. Lay-in Pans: Formed to set in exposed suspension grid.
2. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
3. Snap-in Pans: Designed with dimples or continuous beads on flanges for snap-in, secure engagement with concealed suspension system.

4. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.

C. Pan Thickness: Not less than (As directed).

D. Pan Edge Detail: As directed.

E. Pan Size: As directed.

F. Pan Face Finish: Painted white or as directed.

G. Light Reflectance Coefficient: Not less than 0.70 or 0.75, as directed.

H. NRC: Not less than (As directed).

I. Ceiling Attenuation Class: Not less than 35, 40 or 45 as directed.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Comply with ASTM C635/C635M.

B. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.

2.6 DIRECT-HUNG, STANDARD-GRID, METAL SUSPENSION SYSTEM FOR ACOUSTICAL METAL PAN CEILING

A. Suspension System: For pans, as directed.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A653/A653M, G30 (Z90) coating designation, with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide, sheet metal caps on flanges.

1. Structural Classification: Intermediate or Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted white or as directed.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized according to ASTM A653/653M, G30 (Z90) coating designation, with prefinished, cold-rolled, 9/16-inch- (15-mm-) wide, sheet metal caps on flanges.

1. Structural Classification: Intermediate or Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush or Flanges formed with an integral center reveal.
4. Cap Material: Steel or aluminum cold-rolled sheet.

5. Cap Finish: Painted white or as directed.

D. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized, to produce structural members with 9/16-inch- (15-mm-) wide faces.

1. Structural Classification: Intermediate or Heavy-duty system.
2. Face Design: With 1/8-inch- (3.2-mm-) or 1/4-inch- (6.35-mm-) wide, slotted, box-shaped flange.
3. Face Finish: Painted white or as directed.

E. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A653/A653M, G60 (Z180) coating designation, with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide, aluminum caps on flanges.

1. Structural Classification: Intermediate or Heavy-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white or as directed.

F. Suspension System for Torsion-Spring-Hinged Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring-hinged attachment.

2.7 METAL SUSPENSION SYSTEM FOR ACOUSTICAL SNAP-IN METAL PAN CEILING

A. Manufacturers: Subject to compliance with requirements, provide products by snap-in metal pan ceiling manufacturer.

B. Indirect-Hung, Snap- Tee or Bar System: Designed to support metal pans that snap into main runners, consisting of main runners connected to carrying channels that are attached by hangers to building structure.

C. Access Panels: For access at locations indicated, provide acoustical snap-in metal pan ceiling units.

1. Access Key or Tool: Provide manufacturer's standard key or tool for opening access panels; one or two.

2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Mill Finish: AA-M10C10 (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned).

B. Lacquered Mill Finish: AA-M10C10R1x (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned; Organic Coating: as specified below).

1. Organic Coating: Manufacturer's standard clear organic coating.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.

E. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

F. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness.

2.10 METALLIC-COATED STEEL SHEET FINISHES

A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.11 STEEL SHEET FINISHES

A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness.

B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.

C. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.

1. Install directionally patterned or textured metal pans in directions indicated.

D. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules.

END OF SECTION 095133

SECTION 095423 - LINEAR METAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes strip, linear metal pans and suspension systems for ceilings.

1.2 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawn to scale and coordinating and showing the following:

1. Linear pattern.
2. Joint pattern.
3. Ceiling suspension members.
4. Method of attaching hangers to building structure.
5. Ceiling-mounted items.
6. Ceiling perimeter and penetrations through ceiling; trim and moldings.

B. Product test reports.

C. Evaluation reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E1264 for Class A, Class B, Class C materials.
2. Smoke-Developed Index: As directed 50 or 450 or less.

2.2 LINEAR METAL CEILING PANS

A. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E1264.

1. Mounting Method for Measuring NRC: Type E-400.

B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B209 (ASTM B209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C635/C635M.

a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A879/A879M, 04Z (12G) coating; surface treatment as recommended by finish manufacturer for type of use and finish indicated.
b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A1008/A1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.

C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.

D. Pan Splices: Construction same as pans, in lengths 8 to 12 inches (200 to 300 mm); with manufacturer's standard finish.

E. End Caps: Metal matching pans or Plastic (As directed); fabricated to fit and conceal exposed ends of pans.

F. Filler Strips: Metal matching pans or Plastic (As directed); fabricated to uninterruptedly close voids between pans.

G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.

H. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E84.

I. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E84, and to comply with the following requirements:

2.3 METAL SUSPENSION SYSTEMS

A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C635/C635M requirements.

B. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

1. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: anchors, as directed.
    b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without

failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Zinc-Coated Carbon-Steel Wire; ASTM A641/A641M, Class 1 zinc coating, soft temper

1. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

D. Carriers: Factory finished with matte-black baked finish.

1. Main Carriers: Aluminum, not less than 0.240-inch (6.0-mm) rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with ASTM B209 (ASTM B209M).
2. Main Carriers: Steel, not less than 0.0209-inch (0.53-mm) nominal thickness, cold-rolled sheet, with factory-applied protective coating, complying with ASTM C635/C635M.
3. Flexible Radial Carriers: Manufacturer's standard radial carriers.
4. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.

E. Carrier Splices: Same metal, profile, and finish as for carriers.

F. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.

G. Seismic Struts: Manufacturer's standard.

H. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

2.4 ALUMINUM PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING

A. Aluminum Pans and Suspension System:

B. Classification: Units complying with ASTM E1264 as directed.

1. Pattern: As directed.

C. Pan Thickness: As directed.

D. Pan Edge Detail: As directed.

E. Linear Module Width and Pan Face Width: As directed.

F. Pan Depth: As directed.

G. Pan Face Finish: As directed.

H. End Cap, Finish of Exposed Portions: Matte black to match pan, as directed.

I. Filler Strip Design: Recessed or Flush. An integral extension of pan profile, expansion, for use with expansion carriers or slotted, for air diffusion.

J. Filler Strip, Finish of Exposed Portions: Matte black to match pan.

K. LR: Not less than 0.70 or 0.75, as directed.

L. NRC: Not less than 0.65, 0.75, 0.95, as directed.

M. Suspension-System Main-Carrier Material: As directed.

2.5 STEEL PANS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING

2.6 See the tables at the end of the Evaluations for a list of manufacturers' products. Use these tables in combination with manufacturers' catalogs or product data to specify series, type, model, and designations of other characteristics.

A. Steel Pans and Suspension System:

B. Classification: Units complying with ASTM E1264 as directed.

1. Pattern: As directed.

C. Pan Thickness: As directed.

D. Pan Edge Detail: As directed.

E. Linear Module Width and Pan Face Width: As directed.

F. Pan Depth: As directed.

G. Pan Face Finish: Painted white or as directed.

H. End Cap, Finish of Exposed Portions: Matte black to match pan.

I. Filler Strip Design: Recessed or Flush, An integral extension of pan profile. Expansion, for use with expansion carriers or Slotted, for air diffusion.

J. Filler Strip, Finish of Exposed Portions: Matte black to match pan.

K. LR: Not less than 0.70 or 0.75 as directed.

L. NRC: Not less than 0.65, 0.75, 0.95 as directed.

M. Suspension-System Main-Carrier Material: As directed.

2.7 ALUMINUM FINISHES

A. Mill Finish: AA-M10C10.

B. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.

E. Color-Coated Finish: Manufacturer's standard powder-coat baked paint.

F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 or AAMA 2605 and containing not less than **50** or **70** percent, as directed. PVDF resin by weight.

G. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical, bright-reflective metallic finish free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.8 GALVANIZED-STEEL SHEET FINISHES

A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish.

2.9 STEEL SHEET FINISHES

A. Electroplated Finish: Uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.

B. Bright-Reflective Finish: Uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ASTM C636/C636M and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required, install trapezes or equivalent devices.

4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
6. Do not attach hangers to steel deck tabs or to steel roof deck.

C. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

D. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

F. Install linear metal pans in coordination with suspension system and exposed moldings and trim.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
3. Install pans with butt joints using internal pan splices and in the following joint configuration:

    a. Aligned.
    b. Aligned, every other pan length.
    c. Staggered a minimum of 12 inches (300 mm).
    d. Random.
    e. As indicated.

4. Where metal pan ends are visible, install end caps unless trim is indicated.
5. Install filler strips where indicated.
6. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.

END OF SECTION 095423

SECTION 095436 - SUSPENDED DECORATIVE GRIDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes rigid, open-frame, suspended grids and suspension systems for ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For design of seismic restraints and attachment devices.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints and attachment devices.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.2 SUSPENDED DECORATIVE GRIDS, GENERAL

A. Sheet Metal: Selected for surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.

B. Grid Fabrication: Components are formed from metal indicated. Manufacturer's standard units of size, shape, and profile indicated; finished to comply with requirements indicated. Provide cells factory assembled into modular panel.

C. Cover Profiles and Trim: Provide manufacturer's standard cover profiles and trim for exposed members, and as indicated or required, for edges of grids, at changes in ceiling height, and for other conditions, of same metal and finish as suspended decorative grids.

D. Metal Suspension-System Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C635/C635M requirements. Provide systems complete with runners or beams, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, web covers, load-resisting struts, fixture filler pans, clips and adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

E. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318, greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.

F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) or 0.135-inch- (3.5-mm-) diameter wire.

G. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

H. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

J. Exposed Metal Edge Moldings, Covers, Trim, and Fixture Filler Panels: Provide exposed members as indicated or required to conceal edges of and penetrations through ceiling, to conceal edges of beams, to cover runner webs, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching suspended decorative grids unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.3 ALUMINUM GRID UNITS FOR SUSPENDED DECORATIVE GRIDS If applicable, copy this article and re-edit for each product.

A. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B209 (ASTM B209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

1. Sheet Metal Thickness: As directed.

B. Beam Grid Module: As directed.

C. Beam Width by Height: As directed.

D. Cell Panel Module: As directed.

E. Cell Module: As directed.

F. Cell Profile, Width by Height: As directed.

G. Finish: As directed.

2.4 STEEL GRID UNITS FOR SUSPENDED DECORATIVE GRIDS

A. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C635/C635M.

1. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A879/A879M, 04Z (12G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
2. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A1008/A1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
3. Sheet Metal Thickness: Not less than 0.020 inch (0.5 mm) or 0.024 inch (0.6 mm), as directed.

B. Beam Grid Module: As directed.

C. Beam Width by Height: As directed.

D. Cell Panel Module: As directed.

E. Cell Module: As directed. As directed.

F. Cell Profile, Width by Height: 3/8 by 2 inches (9.5 by 50 mm) or 9/16 by 2 inches (14 by 50 mm), as directed.

G. Finish: As directed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Measure each installation area and establish layout of suspended decorative grids to balance border widths at opposite edges of each space. Comply with layout shown on reflected ceiling plans.

B. Install suspended decorative grids to comply with ASTM C636/C636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

C. Install suspended decorative grids in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to CISCA's "Metal Ceilings Technical Guidelines."

END OF SECTION 095436

SECTION 095443 - STRETCHED-FABRIC CEILING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes site-upholstered ceiling systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each stretched-fabric system.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product certificates.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Build mockup of typical ceiling area as shown on Drawings or as directed by Architect.

1.7 FIELD CONDITIONS

A. Lighting: As directed Do not install stretched-fabric systems until a permanent level of lighting or a lighting level of not less than 50 fc (538 lx) is provided on surfaces to receive stretched-fabric systems.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of stretched-fabric systems that fail in performance, materials, or workmanship within specified warranty period.

1. Warranty Period: As directed Two or Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Stretched-fabric ceiling systems shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency on systems prepared according to ASTM E2573. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.2 STRETCHED-FABRIC CEILING SYSTEMS

A. Stretched-Fabric Ceiling System: Manufacturer's standard system consisting of facing material stretched tightly over a frame and core material and secured in the frame.
1. Core: As directed Manufacturer's standard, Glass-fiber board, Glass-fiber blanket, Mineral-fiber board or Cementitious-fiber board.
2. Frame Edge: Chamfered (beveled), Radiused (bullnosed) or Square as directed.

a. Fabric-Insertion Point: Bottom load.
b. Nominal Frame Thickness: Match core thickness, 1/2 inch (13 mm), 3/4 inch (19 mm), 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (51 mm) or As indicated on Drawings.

3. Reveals between Panels: As directed Recessed, Flush or Projecting reveals as selected by Architect from manufacturer's full range or as indicated on Drawings.

4. Facing Material: Owner-furnished material or As indicated on Drawings.
5. Acoustical Performance: As directed Sound absorption NRC or SAA of 0.50 to 0.90, 0.60 to 0.70, 0.65 to 0.75, not less than 0.65 or not more than 0.35 according to ASTM C423 for Type A mounting according to ASTM E795.

2.3 MATERIALS

A. Sustainable Design Requirements:

B. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612, of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Glass-Fiber Blanket: ASTM C553, ASTM C612, or ASTM C665; of type standard with manufacturer and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
3. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively, and with perforated surface.

C. Frame Construction: Manufacturer's standard, continuous, extruded plastic frame (track).

D. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range or as indicated on Drawings.

1. Applied Treatments: Stain resistance.
2. Lining Material: Manufacturer's standard fabric for each use indicated.

2.4 INSTALLATION MATERIALS

A. Installation Products: Concealed on back of system, recommended by stretched-fabric system manufacturer to support weight of system, fabric tension, and as follows:
1. Fasteners: Manufacturer's standard.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.

B. Before installation, allow fabric to adjust and become stable in spaces where it will be installed according to stretched-fabric system manufacturer's written instructions. Acclimatize fabric for minimum of 24 hours at ambient temperature and humidity conditions indicated for spaces when occupied for their intended use.

3.2 INSTALLATION

A. Install stretched-fabric systems according to system manufacturer's written instructions.

1. Provide continuous perimeter frames of each profile indicated, designed to be inconspicuous when covered by fabric facing, with smooth edges, and with surface finish that will not telegraph through fabric facing.
2. Install framing around penetrations.
3. Tightly fit framing to adjacent construction and securely attach to substrate.
4. Install core material with full coverage, flush with face of stretched-fabric system frame.
5. Attach frame and core to substrate with adhesive or fasteners, or both, to support system and prevent deformation of components.
6. Install stretched-fabric systems true in plane and with fabric square to the grain.

B. Fabric Installation: Apply fabric monolithically in continuous run over area, without joints or reveals, except where panel joints or midspan frames are indicated.

1. Fabric Seams: Sewn seams are not permitted.
2. Fabric Seams: Manufacturer's standard sewn seams, straight and parallel seam dimensions and locations as indicated on Drawings.
3. Stretch and secure fabric to frame edges and so frame and frame attachment method are concealed by fabric unless otherwise indicated.
4. Stretch fabric tightly and square without puckers, ripples, or distortions. Acclimatize and restretch if recommended by stretched-fabric system manufacturer. Repair distortions, wrinkles, and sagging.

3.3 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 095443

SECTION 095446 - FABRIC-WRAPPED CEILING PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, fabric-wrapped ceiling panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For panel assembly and installation.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Panels shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.2 FABRIC-WRAPPED CEILING PANELS

A. Fabric-Wrapped Ceiling Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core or stretched over front face of edge-framed core and bonded or attached to edges and back of frame as directed.

1. Mounting: Back mounted with manufacturer's standard metal clips, suspension system or suspension system with stiffening, back-support angles as directed.
2. Core: Manufacturer's standard, Glass-fiber board, Mineral-fiber board, Cementitious-fiber board, Medium-density fiberboard or Particleboard as directed.
3. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
4. Edge Profile: Chamfered (beveled), Eased (small radius), Mitered (beveled to a point), Radiused (bullnosed), Square or Custom profile as indicated on Drawings.
5. Corner Detail in Elevation: As directed Square, Round, radius as indicated on Drawings or Custom as indicated on Drawings with continuous edge profile indicated.
6. Reveals between Panels: Recessed, Flush or Projecting reveals as selected by Architect from manufacturer's full range or as indicated on Drawings.
7. Facing Material: Owner-furnished material or As indicated on Drawings.
8. Nominal Core or Overall Panel Thickness as directed: 3/4 inch (19 mm), 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (51 mm) or As indicated on Drawings.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612, of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively.

B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range or as indicated on Drawings.

1. Applied Treatments: Stain resistance.
2. Lining Material: Manufacturer's standard fabric for each use indicated.

C. Mounting Devices: Concealed on back of panel, recommended by manufacturer to support weight of panel.

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.

C. Facing Material and Lining Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent panels.

D. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch (1.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panels in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with panel manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

C. Align fabric pattern and grain with adjacent panels.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 095446

SECTION 095753 - SECURITY CEILING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Downward-locking-panel security ceiling assemblies.
2. Security-plank security ceiling assemblies.

1.2 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by Detention Specialist or other entity.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For security ceiling panel units and suspension systems.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Welding certificates.

C. Product test reports.

D. Attachment device test reports.

E. Research reports.

F. Field quality-control reports.

G. Anchor inspection reports.

H. Field quality-control certification signed by Contractor and Detention Specialist.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide security ceiling assemblies with acoustical ratings indicated, as determined according to ASTM E1264 and the following:

1. Noise Reduction Coefficient (NRC): ASTM C423 and ASTM E795 in Type E-400 mounting.
2. Ceiling Attenuation Class (CAC): ASTM E1414/E1414M.

B. Seismic Standard: Provide ceilings designed and installed to withstand the effects of earthquake motions according to ASCE/SEI 7.

2.2 DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY

A. Provide a complete, integrated assembly, including security ceiling panels, exposed suspension system, perimeter supports, and accessories.

B. Panels: Fabricated from a single sheet of metal, with formed upturned edges on all four sides designed to continuously engage with and lock under rectangular bulb of suspension system.

1. Steel Panels: Metallic-coated steel with minimum uncoated sheet thickness of 0.043 inch (1.09 mm), 0.033 inch (0.84 mm) or 0.021 inch (0.53 mm) as directed.
2. Panel Size: 12 by 24 inches (305 by 610 mm), 12 by 48 inches (305 by 1220 mm), 24 by 24 inches (610 by 610 mm) or 24 by 48 inches (610 by 1220 mm) as directed.
3. Perforation Pattern: Manufacturer's standard or Unperforated as directed.
4. Noise Reduction Coefficient (NRC): 0.70, 0.80, 0.85, 0.90, 0.95 or 1.00 as directed.

C. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling panels.

1. Spacer Grids: Metallic-coated-steel grid units.
2. Support Clips: Metal clips.

D. Backer Plates: Unperforated units formed from metallic-coated steel sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:

1. Ceiling Attenuation Class (CAC): 40 or 45 as directed.
2. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.

E. Access Panels: Material, perforation pattern, and finish same as security ceiling panels. Provide panels at locations indicated on Drawings.

1. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware", Section 087111 "Door Hardware (Descriptive Specification)" or Section 087163 "Detention Door Hardware" as directed

F. Suspension System: ASTM C635/C635M, heavy-duty exposed system consisting of snap-in main runners supported by hangers attached to building structure.

1. Provide system complete with main runners, splice plates, connector and alignment clips, hangers, trim, seismic- and wind-load clips and struts, and other suspension components required to support security ceiling units and other security ceiling-supported construction.
2. Main Runners and Cross Tees: Formed from metal sheet, 1-1/2 inches (38 mm) high, with 15/16-inch (23.8-mm) flange width and with oversized rectangular bulb for engaging panels.

    a. Material: Galvanized steel, G90 (Z275) zinc coating or Electrolytic zinc-coated steel, 40Z (12G) zinc coating as directed.

3. Wire Hangers, Braces, and Ties: Zinc-coated, carbon-steel wire, ASTM A641/A641M, Class 1 zinc coating, soft temper.

    a. Size: Select wire diameter so its stress at 3 times the hanger design load (ASTM C635/C635M, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

4. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
5. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
6. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide, formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet, G90 (Z275) zinc coating, with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
7. Compression Struts: Fabricated from 3/4-inch- (19-mm-) diameter steel tubing, designed to fit over rectangular bulb of suspension system.
8. Security Clips: Steel wire, designed to slip over suspension system and through holes in flanges of panel to prevent panel removal.

G. Perimeter Supports: Wall-mounted channel moldings and wall angles; fabricated from 0.042-inch- (1.06-mm-) thick galvanized steel or 0.016-inch- (0.4-mm-) thick galvanized steel as directed; finished to match suspension system.

H. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions; of metal and finish matching security ceiling panels.

2.3 SECURITY-PLANK SECURITY CEILING ASSEMBLY

A. Single-Configuration Panels: Fabricated from a single sheet of metal, with a self-locking male/female lap joint for joining panels.
   1. Steel Panels: Electrolytic zinc or Metallic-coated steel with minimum uncoated sheet thickness of 0.097 inch (2.45 mm), 0.068 inch (1.72 mm), 0.053 inch (1.34 mm), 0.043 inch (1.09 mm) or 0.033 inch (0.84 mm) as directed.
   2. Panel Width: 12 inches (305 mm), 18 inches (457 mm) or 24 inches (610 mm) as directed.
   3. Panel Length: Minimum 8 feet (2.4 m), Minimum 10 feet (3.0 m), Minimum 12 feet (3.7 m) or Custom lengths to fit areas indicated as directed.
   4. Perforation Pattern: Manufacturer's standard or Unperforated as directed.
   5. Noise Reduction Coefficient (NRC): 0.70, 0.80, 0.85, 0.90, 0.95 or 1.00 as directed.

B. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling planks.

   1. Spacer Grids: Metallic-coated-steel grid units.
   2. Support Clips: Metal clips.

C. Backer Plates: Unperforated units formed from metallic-coated steel sheet that reduces travel of sound through panel and that makes panel assembly comply with the following performance:

   1. Ceiling Attenuation Class (CAC): 40 or 45 as directed.
   2. Sound-Absorptive Pads: Provide secondary sound-absorptive pads, same as specified for primary pads, for placement over backer plates to reduce plenum sound.

D. Access Panels: Material, perforation pattern, and finish same as security ceiling panels. Provide at locations indicated on Drawings.

   1. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware", Section 087111 "Door Hardware (Descriptive Specification)" or Section 087163 "Detention Door Hardware" as directed

E. Closures: Fabricated from minimum 0.053-inch- (1.34-mm-) thick steel sheet, finished to match security ceiling panels. Fasten with security fasteners or by welding.

F. Suspension System: Heavy-duty exposed system consisting of intermediate carriers supported by secondary support system attached to building structure.

   1. Intermediate Carriers: Formed from tees with a nominal 4-inch- (102-mm-) wide exposed face or built up from back-to-back angles or channels each with a nominal 2-inch- (51-mm-) wide exposed face.

      a. Steel Intermediate Carriers: As directed Electrolytic zinc or Metallic-coated steel with minimum uncoated sheet thickness of 0.097 inch (2.45 mm), 0.068 inch (1.72 mm), 0.053 inch (1.34 mm) or 0.043 inch (1.09 mm), finished to match security ceiling panels.

   2. Secondary Support System:

      a. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

b. Angle Hangers: 1-1/2-by-1-1/2-inch (38-by-38-mm) galvanized-steel angles, G90 (Z275) zinc coating, bolted to intermediate carriers and building structure.

G. Perimeter Supports: Wall-mounted angles, tees, and bearing plates.

1. Steel Perimeter Supports: As directed Electrolytic zinc or Metallic-coated steel with minimum uncoated sheet thickness of 0.167 inch (4.20 mm), 0.097 inch (2.45 mm), 0.068 inch (1.72 mm), 0.053 inch (1.34 mm) or 0.043 inch (1.09 mm), finished to match security ceiling panels.

H. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions, of metal and finish matching security ceiling panels.

2.4 SOUND-ABSORPTIVE PADS

A. Plastic-Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, vinyl chloride plastic sheet encapsulating unfaced mineral-fiber insulation.

1. Thickness: 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (51 mm), 4 inches (102 mm) or As required to meet NRC rating as directed.
2. Surface-Burning Characteristics:

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or 450 or less as directed.

2.5 METALLIC-COATED STEEL SHEET FINISHES

A. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.6 STEEL FINISHES

A. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: Manufacturer's standard white.

2.7 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
   1. Drive-System Type: Pinned Torx-Plus or Pinned Torx as directed.

2.8 SECURITY SEALANTS

A. Polyurethane Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement.

B. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.

C. Acoustical Sealant: Manufacturer's standard, nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

2.9 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welding.

C. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements.

B. Inspect built-in and cast-in anchor installations before installing security ceiling assemblies to verify that anchor installations comply with requirements.

3.2 GENERAL INSTALLATION

A. Comply with CISCA's "Ceiling Systems Handbook" for installation of security ceiling assemblies.

B. Install perimeter supports around perimeter of security ceiling area.

1. Sealant: As directed Apply polyurethane security, epoxy security or acoustical sealant in a continuous ribbon concealed on back of vertical legs of supports before they are installed.
2. Attach supports with anchor bolts or expansion anchors spaced not more than 12 inches (305 mm) o.c. and not more than 3 inches (76 mm) from ends. Miter corners accurately.

    a. Level perimeter supports with suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.7 m).

3. Do not use exposed fasteners, including pop rivets, on moldings and trim. If exposed fasteners are unavoidable, obtain prior written approval from Architect for their use and use security fasteners.

C. Install accessories where indicated and as required to comply with performance requirements.

1. Sound-Absorptive Pads: For security ceiling panels indicated, provide sound-absorptive pads of width and length to completely fill inside of each security ceiling panel.

    a. Install sound-absorptive pads over metal spacer grids with support clips.

2. Backer Plates: Install plates in areas indicated on reflected ceiling plans or in room finish schedules. Lay backer plates directly on security ceiling assembly in manner indicated and close major openings to form complete coverage in required areas. Lay second sound-absorptive pad on backer plate.

D. Seismic Installation: Comply with seismic standard indicated, manufacturer's written instructions, and CISCA's "Ceiling Systems Handbook."

3.3 DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY INSTALLATION

A. Ceiling Hangers: Suspend from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within security ceiling plenum that are not part of supporting structure or of security ceiling suspension system.
2. Splay hangers only where required to avoid obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to security ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts,

eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support security ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts or postinstalled mechanical or adhesive anchors.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1220 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
12. Install compression struts extending from main runners to structure above and spaced at 48 inches (1220 mm) o.c.

B. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

C. Panel Installation: Install panels to continuously engage with and lock under rectangular bulb of suspension system. Attach panels to perimeter supports with security fasteners not more than 3 inches (76 mm) from edges of panel. Fasten through exposed face of supports into panel.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating security ceiling.
3. Install directionally patterned panels in directions indicated.
4. Scribe and cut security ceiling panels for accurate fit at borders and at interruptions and penetrations by other work through security ceilings. Stiffen edges of cut panels as required to eliminate evidence of buckling or variations in flatness.

D. Access Panels: Install each access panel only where indicated and within one security ceiling panel.

3.4 SECURITY-PLANK SECURITY CEILING ASSEMBLY INSTALLATION

A. Install security planks with long edges continuously interlocked. Adjust security planks to final position before permanently fastening. Provide minimum 1-1/2-inch (38-mm) end bearing.

1. Attach adjacent security planks to each other with security fasteners spaced not more than 12 inches (305 mm) o.c. and not more than 6 inches (152 mm) from ends.

2. Continuously weld ends of security planks to perimeter supports. Remove exposed projecting burrs, edges, and rough spots resulting from welding operations by grinding smooth.
3. Attach ends of security planks to perimeter supports with security fasteners not more than 3 inches (76 mm) from edges of security plank. Fasten through exposed face of supports into security planks.
4. Provide intermediate carriers for ends of security planks that are not supported by perimeter supports. To attach security planks to intermediate carriers, use same method as that used for attaching security planks to perimeter supports.

    a. Support intermediate carriers from structure above by secondary support system spaced at 48 inches (1220 mm) o.c. and bolted to carriers.

B. Access Panels: Install each access panel only where indicated and within one security plank.

C. Provide steel angle reinforcement on each side of openings that exceed 12 inches (305 mm) in any direction.

3.5 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Prepare field quality-control certification endorsed by Detention Specialist that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION 095753

SECTION 096229 - CORK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cork floor tile.
2. Engineered cork floor tile.
3. Cork floating floor system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For cork flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 CORK FLOOR TILE

A. Composition: 100 percent natural cork bark and recycled cork granules and set in a natural or synthetic, flexible resin matrix; homogeneous and uniform in composition throughout the tile thickness.

B. Nominal Density: Manufacturer's standard, 30 lb/cu. ft. (480 kg/cu. m), minimum, 34 lb/cu. ft. (544 kg/cu. m), minimum or 37 lb/cu. ft. (592 kg/cu. m), minimum as directed.

C. Nominal Thickness: 0.156 inch (4.0 mm), 0.180 inch (4.8 mm) or 0.312 inch (8.0 mm) as directed.

D. Nominal Size: 12 by 12 inches (305 by 305 mm), 12 by 24 inches (305 by 610 mm) or 24 by 24 inches (610 by 610 mm) as directed.

E. Color: Light natural, Medium natural, Dark natural, As indicated by manufacturer's designations or Match Architect's sample.

F. Factory Finish: Sanded or unfinished, Waxed, Polyurethane, Polyurethane containing UV inhibitors, Acrylic, As indicated by manufacturer's designations or Match Architect's sample as directed.

2.3 ENGINEERED CORK FLOOR TILE

A. Composition: 100 percent natural cork bark and recycled cork granules with laminated, patterned cork veneers and set in a natural or synthetic, flexible resin matrix; homogeneous and uniform in composition throughout the tile thickness.

B. Nominal Density: Manufacturer's standard, 30 lb/cu. ft. (480 kg/cu. m), minimum, 34 lb/cu. ft. (544 kg/cu. m), minimum or 37 lb/cu. ft. (592 kg/cu. m), minimum as directed.

C. Nominal Thickness: 0.156 inch (4.0 mm), 0.180 inch (4.8 mm) or 0.312 inch (8.0 mm) as directed.

D. Nominal Size: 12 by 12 inches (305 by 305 mm), 12 by 24 inches (305 by 610 mm) or 24 by 24 inches (610 by 610 mm) as directed.

E. Color: Light natural, Medium natural, Dark natural, As indicated by manufacturer's designations or Match Architect's sample.

F. Pattern: As indicated by manufacturer's designations or Match Architect's sample.

G. Factory Finish: Sanded or unfinished, Waxed, Polyurethane, Polyurethane containing UV inhibitors, Acrylic, As indicated by manufacturer's designations or Match Architect's sample.

2.4 CORK FLOATING FLOOR SYSTEM

A. Construction: Laminated planks made of two cork layers, top and bottom, that sandwich a medium-density fiberboard core.

B. Plank Density:

1. Cork Top Layer: 28 lb/cu. ft. (448 kg/cu. m).
2. Interlocking Medium-Density Fiberboard Core: 45 lb/cu. ft. (720 kg/cu. m) or Manufacturer's standard density.
3. Cork Underlayment Layer: 13 lb/cu. ft. (208 kg/cu. m) or Manufacturer's standard density as directed.

C. Plank Thickness: As directed 0.450-inch (11.4-mm) or Manufacturer's standard overall nominal thickness made up as follows:

1. Cork Top Layer: As directed 0.125-inch (3.2-mm) or Manufacturer's standard nominal thickness.
2. Interlocking Medium-Density Fiberboard Core: As directed 0.250-inch (6.3-mm) or Manufacturer's standard nominal thickness.
3. Cork Underlayment Layer: As directed 0.078-inch (2.0-mm) or Manufacturer's standard nominal thickness.

D. Plank Size: 36 by 12 inches (900 by 305 mm).

E. Plank Edge: Tongue-and-groove type or Manufacturer's standard interlock as directed.

F. Color: Light natural, Medium natural, Dark natural, As indicated by manufacturer's designations or Match Architect's sample.

G. Pattern: As indicated by manufacturer's designations or Match Architect's sample.

H. Factory Finish: Sanded or unfinished, Waxed, Polyurethane, Polyurethane containing UV inhibitors, Acrylic, As indicated by manufacturer's designations or Match Architect's sample.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by cork flooring manufacturer for applications indicated.

B. Vapor Retarder: ASTM D4397, polyethylene sheet not less than 6.0 mils (0.15 mm) or 8.0 mils (0.2 mm) thick as directed.

C. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit cork flooring and substrate conditions indicated. Insert underlayment material requirements if cork flooring is installed on wood substrates. Consult cork flooring manufacturers for additional information.

2.6 FIELD-APPLIED FINISHES

A. Sealer: Product as recommended by cork flooring manufacturer.

B. Paste Wax: Products as recommended by cork flooring manufacturer.

C. Finish Coatings: Products containing UV inhibitors as recommended by cork flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to cork flooring manufacturer's written instructions to ensure adhesion of cork flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by cork flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by cork flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 or 10 pH as directed.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) as directed and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install cork flooring until materials are the same temperature as space where they are to be installed.

1. At least 72 hours in advance of installation, move cork flooring products and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by cork flooring.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing cork flooring.

B. Mix together floor tiles from each carton to ensure uniform distribution of shade.

C. Discard broken, cracked, chipped, or deformed floor tiles.

D. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

E. Lay floor tiles square with room axis at a 45-degree angle with room axis in ashlar or staggered joint pattern or in pattern indicated.

F. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

G. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

I. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of appearance between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

J. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CORK FLOATING FLOOR SYSTEM INSTALLATION

A. Comply with manufacturer's written instructions for installing cork floating floor system.

B. Install continuous vapor retarder over substrate, taping side and end laps.

C. Mix floor planks from several cartons to ensure uniform distribution of shade.

D. Discard broken, cracked, chipped, or deformed floor planks.

E. Do not attach floor planks to substrate.

F. Tightly interlock and adhere plank edges with adhesive. Remove excess adhesive from top surface of planks.

G. Lay floor planks in pattern indicated.

H. Use spacers to keep floor planks from shifting as subsequent rows are added. Remove spacers after installing cork floating floor system.

I. Maintain expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings of not less than 3/8 inch (9.5 mm).

J. Extend floor planks into toe spaces, door reveals, closets, and similar openings. Extend floor planks to center of door openings.

K. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor planks as marked on substrates. Use chalk or other nonpermanent marking device.

3.4 FIELD-APPLIED FINISHES

A. Apply finishes according to cork flooring manufacturer's written instructions.

B. Cork Sealer: Apply one or two coat(s) as directed.

C. Paste Wax: Apply one, two or three coat(s) as directed.

D. Finish Coatings: Apply two or three coat(s) as directed.

END OF SECTION 096229

SECTION 096313 - BRICK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick flooring set on thickset mortar bed.
2. Brick flooring set in thinset mortar directly on concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Sustainable Design Submittals: Retain option in "Samples" Paragraph below if flooring is grouted and grout color approval is required.

C. Samples: For each type of brick and for grout and accessories involving color selection.

1.3 FIELD CONDITIONS

A. Environmental Limitations: Do not set brick flooring when air temperature or material temperature is below 40 deg F (4.4 deg C). Maintain minimum ambient temperature of 40 deg F (4.4 deg C) during installation and for 48 hours after completion.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Brick Pavers: As directed Light-traffic paving brick complying with ASTM C902, Class SX, Class MX, Class NX, Type I, Type II, Type III, Application PS, Application PX or Application PA, without frogs or cores in surfaces exposed to view in the completed Work.

B. Size: Actual dimensions as follows:

1. Thickness: 1-1/4 inches (32 mm), 1-5/8 inches (41 mm) or 2-1/4 inches (57 mm) as directed.
2. Face Dimensions: 3-5/8 by 7-5/8 inches (92 by 194 mm), 4 by 8 inches (102 by 203 mm), 3-5/8 by 11-5/8 inches (92 by 295 mm) or 7-5/8 by 7-5/8 inches (194 by 194 mm) as directed.

C. Colors and Textures: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range as directed.

D. Temporary Protective Coating: Precoat exposed surfaces of brick pavers at factory with a continuous film of a temporary protective coating that is compatible with brick, mortar, and grout products.

2.2 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II.

B. Hydrated Lime: ASTM C207, Type S.

C. Aggregate: ASTM C144.

D. Latex Additive: As directed Manufacturer's standard, acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

E. Cleavage Membrane: Asphalt-saturated felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.

F. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062 inch (1.57 mm) in diameter; comply with ASTM A185/A185M and ASTM A82/A82M except for minimum wire size.

G. Thinset Mortar: Latex-portland-cement mortar complying with ANSI A118.4.

2.3 GROUT MATERIALS

A. Sand-Portland-Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

1. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in portland-cement grout.

B. Standard Cement Grout: ANSI A118.6, sanded.

C. High-Performance Tile Grout: ANSI A118.7, sanded.

D. Colors: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

E. Water: Potable.

2.4 MISCELLANEOUS MATERIALS

A. Expansion- and Control-Joint-Filler Strips: ASTM D1752, cork or self-expanding cork.

B. Sealer: Colorless, stain- and slip-resistant sealer, not affecting color or physical properties of brick and grout surfaces and specifically recommended by sealer manufacturer for use indicated.

C. Floor Polish: ASTM D4078, formulated for use over sealer indicated, acceptable to sealer manufacturer, and specifically recommended by floor-polish manufacturer for use indicated.

1. Slip Resistance: Floor polish shall have a static coefficient of friction of at least 0.5 when tested according to ASTM D2047.

2.5 MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout when they have reached their initial set.

B. Portland-Cement-Lime Setting-Bed Mortar: ASTM C270, Type S or Type N, Proportion Specification as directed.

C. Latex-Modified Portland-Cement Setting-Bed Mortar: Proportion and mix according to written instructions of liquid-latex manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive brick.

D. Mortar-Bed Bond Coat: Mix neat cement and latex additive or water to a creamy consistency as directed.

E. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.

F. Portland-Cement Bond Coat: Mix neat cement and water to a creamy consistency.

G. Thinset Mortar: Proportion and mix according to manufacturer's written instructions.

H. Job-Mixed Grout: Proportion and mix portland cement and aggregate grout to match setting-bed mortar, except omit hydrated lime and use enough water to produce a pourable mixture.

I. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Remove substances from subfloor that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Mix bricks from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut bricks with motor-driven masonry saw to provide clean, sharp, unchipped edges. Use full units without cutting where possible.

D. Joint Pattern: Running bond, Herringbone, Basket weave, As indicated or Match existing brick flooring joint pattern as directed.

E. Hand-Tight Joints: Set brick with hand-tight joints where indicated.

F. Spaced Joint Widths: Provide nominal 3/8-inch (10-mm) or 1/2-inch (13-mm) joint width with variations not exceeding plus or minus 1/16 inch (1.6 mm), 1/8 inch (3 mm) or unless otherwise indicated.

G. Finished-Surface Tolerances: Do not exceed 1/16-inch (1.5-mm) brick-to-brick offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of brick flooring.

H. Expansion and Control Joints: Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting brick flooring.

3.2 THICKSET BRICK FLOORING

A. Apply mortar bed to concrete subfloors to comply with the following requirements:

1. Saturate concrete subfloor with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
2. Apply mortar-bed bond coat over surface of concrete subfloor about 15 minutes before placing mortar bed. Do not exceed 1/16-inch (1.6-mm) thickness. Limit area of mortar-bed bond coat to avoid its drying out before placing setting bed.
3. Apply mortar bed immediately after applying mortar-bed bond coat. Spread and screed setting bed to uniform thickness at elevations required for accurate setting of brick to finished elevations indicated.
4. Brick Wet Set on Workable Mortar Bed: Mix and place only that amount of mortar bed that can be covered with brick before initial set. Cut back, bevel edge, and discard setting-bed material that has reached initial set before placing brick.
5. Brick Set on Cured Mortar Bed: Cure mortar bed for not less than 20 hours at 70 deg F (21 deg C).

B. Apply mortar bed over cleavage membrane or waterproofing to comply with the following requirements as directed:

1. Place cleavage membrane over subfloor surfaces indicated to receive brick flooring, lapped at least 4 inches (100 mm) at joints.
2. Place reinforcing wire fabric over membrane, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of setting bed. Hold edges back from vertical surfaces approximately 1/2 inch (13 mm).
3. Place mortar bed over cleavage membrane with reinforcing wire fabric fully embedded in middle of setting bed. Spread and screed setting bed to uniform thickness at elevations required for accurate setting of brick to finished elevations indicated.
4. Brick Wet Set on Workable Mortar Bed: Mix and place only that amount of mortar bed that can be covered with brick before initial set. Cut back, bevel edge, and discard setting-bed material that has reached initial set before placing brick.
5. Brick Set on Cured Mortar Bed: Cure mortar bed for not less than 20 hours at 70 deg F (21 deg C).

C. Install brick either in workable mortar bed or over cured mortar bed at Contractor's option.

D. Install brick in workable mortar bed to comply with the following requirements:

1. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow brick to absorb the water so it is damp but not wet at the time of laying.
2. Place brick before initial set of mortar takes place. Immediately before placing brick on setting bed, apply uniform 1/16-inch- (1.6-mm-) thick bond coat to mortar bed or to back of each brick with a flat trowel.
3. Tamp or beat brick with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each brick in a single operation before initial set of mortar; do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjusting joints.

E. Install brick over cured mortar bed to comply with the following requirements:

1. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow brick to absorb the water so it is damp but not wet at the time of laying.
2. Apply thinset mortar to setting bed with notched trowel complying with manufacturer's specifications for notch depth and configuration and in heavy enough layer to provide a minimum mortar-bed thickness of 3/32 to 1/8 inch (2.5 to 3 mm) after bricks are fully embedded. Key the mortar into setting bed with flat side of trowel and comb with notched side of trowel in one direction. Apply only as much mortar as can be covered with brick before initial set (15 to 30 minutes).
3. Place brick while thinset mortar is still tacky and before initial set takes place. Immediately before placing brick on setting bed, apply skim coat of thinset mortar to back of brick. Place brick by sliding in direction perpendicular to combed ridges and tamp or beat brick with a small beating block to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances; do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjusting joints.

3.3 THINSET BRICK FLOORING

A. Install brick flooring on concrete subfloor with thinset mortar to comply with the following requirements:

1. Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C67. Allow brick to absorb the water, so it is damp but not wet at the time of laying.
2. Apply thinset mortar to subfloor with notched trowel complying with manufacturer's specifications for notch depth and configuration and in heavy enough layer to provide a minimum mortar-bed thickness of 3/32 to 1/8 inch (2.5 to 3 mm) after bricks are fully embedded. Key the mortar into substrate with flat side of trowel and comb with notched side of trowel in one direction. Apply only as much mortar as can be covered with brick before initial set (15 to 30 minutes).
3. Place brick while mortar is still tacky and before initial set takes place. Immediately before placing brick, apply skim coat of thinset mortar to back of brick. Place brick by

sliding in direction perpendicular to combed ridges and tamp or beat brick with a small beating block to obtain full contact with mortar and to bring finished surfaces within indicated tolerances; do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjusting joints.

3.4 JOINT TREATMENT

A. Hand-Tight Joints: Sweep dry mixture of portland cement and sand into joints, then fog surface with water to set mixture.

B. Grouted Joints: Grout brick joints complying with ANSI A108.10.

C. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining brick and other surfaces. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free from drying cracks.

D. Cure grout by maintaining it in a damp condition for seven days unless otherwise recommended by grout manufacturer.

3.5 CLEANING AND PROTECTION

A. Cleaning: Remove excess mortar and grout from exposed brick surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to brick and grout manufacturers. Trap and remove coating to prevent it from clogging drains.

B. Sealing and Polishing: After floor has been cleaned and is thoroughly dry, seal and polish traffic surface of brick flooring in a manner that results in a clear, uniform appearance. Apply sealer and floor polish in the number of coats and by application methods that comply with written directions of manufacturer of each product. Do not apply floor polish until sealer has dried.

END OF SECTION 096313

SECTION 096313.35 - CHEMICAL-RESISTANT BRICK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chemical-resistant brick, used for flooring, base, and lining.
2. Industrial floor brick, used for flooring, base, and lining.
3. Portland-cement mortar and chemical-resistant resin grout.
4. Chemical-resistant resin mortar and chemical-resistant resin grout.
5. Chemical-resistant membrane.
6. Chemical-resistant joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: Full-size units of each type of brick indicated.

PART 2 - PRODUCTS

2.1 BRICK

A. Chemical-Resistant Brick: Solid (uncored), unfrogged brick complying with ASTM C279, Type I, Type II or Type III, shape, and size indicated as directed.

1. Colors of Exposed Brick Surfaces: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range as directed.
2. Provide brick with smooth wearing surfaces, slip-resistant wearing surfaces with abrasive content, diagonal-scored wearing surfaces and scored bonding surfaces, wire-cut bonding surfaces or scored or wire-cut bonding surfaces, as standard with manufacturer as directed.

B. Industrial Floor Brick: As directed Solid (uncored), unfrogged brick complying with ASTM C410, Type T, Type H, Type M or Type L, shape, and size indicated.

1. Colors of Exposed Brick Surfaces: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.
2. Provide brick with smooth wearing surfaces, slip-resistant wearing surfaces with abrasive content or diagonal-scored wearing surfaces and scored bonding surfaces, wire-cut bonding surfaces or scored or wire-cut bonding surfaces, as standard with manufacturer as directed.

C. Base: Provide matching base at walls and vertical elements. Include special shapes for internal and external corners, stops, and where indicated.

1. Type: As indicated, Square-top cove, Round-top cove or Turn-up base.

D. Temporary Protective Coating: Coat exposed faces of brick with a thick continuous film of a temporary protective coating. Use coating that is compatible with brick and with mortar and grout products and that can be removed without damaging grout or brick, as recommended by brick and mortar and grout manufacturers. Do not coat unexposed brick surfaces.

2.2 PORTLAND-CEMENT-MORTAR SETTING-BED MATERIALS

A. Cement: Portland cement, ASTM C150/C150M, Type I.

B. Aggregate: ASTM C144.

C. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4 mils (0.1 mm) thick.

D. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50 by 50 mm) by 0.062-inch- (1.6-mm-) diameter wire complying with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.

E. Water: Potable.

2.3 CHEMICAL-RESISTANT MORTAR AND JOINT MATERIALS

A. General: Provide products of formulation recommended by manufacturer for application indicated.

B. Resin Mortar for Setting Bed: ASTM C395, with furan, epoxy, phenolic, polyester, vinyl-ester resin and carbon or silica filler as directed.

C. Resin Mortar for Joints: ASTM C395, with same resin and filler as setting bed, furan resin and carbon filler, high-adhesion furan resin and carbon filler or vinyl-ester resin and silica filler as directed.

1. Colors of Exposed Joints: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

D. Resin Grout: ASTM C658, with furan, epoxy or vinyl-ester resin and carbon or silica filler.

1. Colors of Exposed Joints: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

E. Chemical-Resistant Membrane: Multiple-component asphaltic system consisting of asphalt primer and asphalt-impregnated, woven glass-fiber cloth embedded in hot-melt asphalt compound, as recommended and produced by mortar and grout manufacturer for type of application indicated.

F. Chemical-Resistant Joint Sealant: Chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with a proven service record and compatible with brick and other setting materials. Include primer and backer rod recommended by manufacturer.

1. Colors of Exposed Joints: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Remove substances from subfloor that could impair bond of mortar, including curing and sealing compounds, form oil, and laitance.

B. Do not use bricks with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in the finished Work.

C. Cut bricks with motor-driven masonry saw to provide clean, sharp, unchipped edges. Hammer cutting is not acceptable. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

D. Joint Pattern and Widths:

1. Lay brick in running bond, herringbone pattern, joint pattern shown or joint pattern matching existing brick flooring as directed.

E. Finished Surface Tolerances: Do not exceed 1/32-inch (1-mm) unit-to-unit offset from flush lippage or a tolerance of 1/8 inch in 10 feet (3 mm in 3 m) from level or slope as indicated for finished surface of flooring.

F. Finished Surface Tolerances: Do not exceed 1/16-inch (1.5-mm) unit-to-unit offset from flush lippage or a tolerance of 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level or slope as indicated for finished surface of brick flooring.

3.2 CHEMICAL-RESISTANT RESIN-MORTAR APPLICATIONS

A. Chemical-Resistant Membrane: Provide chemical-resistant asphaltic membrane system over concrete substrates beneath chemical-resistant mortar applications where indicated. Comply with membrane manufacturer's written directions for installing membrane.

B. Flood Test Membrane: According to ASTM D5957, before installing brick flooring, remove water and dry membrane.

C. Bricklayer's Method: Comply with ASTM C399 and mortar manufacturer's written directions. Lay units in resin-mortar setting bed, and provide full joints of resin mortar by spreading or buttering mortar on sides of units before setting them in place.

D. Tile Setter's Method: Comply with ASTM C723 and mortar and grout manufacturer's written directions. Lay units in resin-mortar setting bed, and fill joints with resin grout.

E. Vertical Surfaces: Set units with resin mortar for joints, including back joint, to comply with ASTM C399.

3.3 PORTLAND-CEMENT-MORTAR AND RESIN-GROUT APPLICATIONS

A. Comply with ASTM C398 for application of units in portland-cement-mortar setting bed. Comply with ASTM C723 and grout manufacturer's written directions for grouting joints with resin grout of type indicated.

B. Cleavage Membrane: Install a continuous membrane with 2-inch- (50-mm-) minimum lapped joints over subfloor.

C. Setting-Bed Reinforcement: Install continuous welded-wire fabric with 4-inch- (100-mm-) minimum lapped joints in setting bed.

D. Vertical Surfaces: Install units to comply with ASTM C399 using resin mortar for joints.

3.4 INSTALLING JOINT SEALANTS

A. Do not fill joints that are to receive sealant. Prepare joints for sealant by raking joints clean for depth of unit thickness plus setting bed as indicated.

B. Install joint sealants, including chemical-resistant sealants specified in this Section, primer, and backer rod, to comply with sealant manufacturer's written directions and Section 079200 "Joint Sealants."

3.5 CLEANING

A. Cleaning: Remove excess mortar and grout from exposed brick surfaces, wash, and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to brick and grout manufacturers. Trap and remove coating to prevent it from clogging drains.

END OF SECTION 096313.35

SECTION 096340 - STONE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimension stone exterior flooring.
2. Dimension stone interior flooring.
3. Dimension stone stair treads and risers.
4. Dimension stone thresholds.

B. Related Requirements:

1. Section 093033 "Stone Tiling."
2. Section 321400 "Unit Paving" for stone pavers.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Samples:

1. For each stone type indicated. Include at least (as directed) or more Samples in each set and show the full range of color and other visual characteristics in completed Work.
2. For each color of grout or pointing mortar required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stone flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical interior floor area about 96 inches (2400 mm) square.
2. Build mockup of typical exterior pavement area about 96 inches (2400 mm) square.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

A. Maintain air and material temperatures to comply with requirements of installation material manufacturers, but not less than 50 deg F (10 deg C) during installation and for seven days after completion.

B. Cold-Weather Requirements for Exterior Stone Flooring: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Hot-Weather Requirements for Stone Flooring: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. Maintain temperature of materials below 100 deg F (38 deg C).
2. When the ambient temperature exceeds 90 deg F (32 deg C), fog spray installed stone flooring until damp at least three times a day until flooring is three days old.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, as directed.

C. Finish: As directed.

2.3 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Stone Abrasion Resistance: Minimum value of 10, as directed based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements as directed.

C. Finish: As directed.

2.4 MARBLE

A. Material Standard: Comply with ASTM C503/C503M.

1. Stone Abrasion Resistance: Minimum value of 10, as directed based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements and as directed.

C. Finish: Polished or Honed, as directed.

2.5 QUARTZ-BASED STONE

A. Material Standard: Comply with ASTM C616/C616M, as directed.

1. Stone Abrasion Resistance: Minimum value of 10, as directed, based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements and as directed.

C. Finish: As directed.

2.6 SERPENTINE

A. Material Standard: Comply with ASTM C1526, Classification I Exterior or Classification II Interior.

1. Stone Abrasion Resistance: Minimum value of 10, as directed, based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements and as directed.

C. Finish: Polished or Honed, as directed.

2.7 SLATE

A. Material Standard: Comply with ASTM C629/C629M, Classification I Exterior or Classification II Interior.

1. Stone Abrasion Resistance: Minimum value of 8 or as directed, based on testing according to ASTM C241/C241M or ASTM C1353.

B. Description: As directed, slate with a fine, even grain and unfading color, from clear, sound stock.

C. Varieties and Sources: Subject to compliance with requirements and as directed.

D. Finish: As directed.

2.8 TRAVERTINE

A. Material Standard: Comply with ASTM C1527/C1527M, Classification I Exterior or Classification II Interior.

1. Stone Abrasion Resistance: Minimum value of 10 or as directed, based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements and as directed.

C. Cut: Vein.

D. Filling: Fill pores on faces of stone with cementitious filler of color as directed.

E. Finish: As directed.

2.9 OTHER STONE

A. Material Standards:

1. Maximum Absorption according to ASTM C97/C97M: as directed.
2. Minimum Compressive Strength according to ASTM C170/C170M: as directed.
3. Stone Abrasion Resistance: Minimum value of 10 or 12 as directed, based on testing according to ASTM C241/C241M or ASTM C1353.

B. Varieties and Sources: Subject to compliance with requirements and as directed.

C. Finish: As directed.

2.10 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.

D. Aggregate: ASTM C144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.

1. White Aggregates: Natural white sand or ground white stone.

2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

E. Latex Additive: acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part of or all gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

F. Thinset Mortar:
1. Standard Dry-Set Mortar: ANSI A118.1.
2. Modified Dry-Set Mortar: ANSI A118.4.
3. Medium-Bed Modified Dry-Set Mortar: ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch (16 mm), as directed.
4. Improved Modified Dry-Set Mortar: ANSI A118.15.

G. Water: Potable.

2.11 GROUT

A. Grout Colors: Match stone, as directed.

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.

C. Standard Cement Grout: ANSI A118.6, packaged.

1. Unsanded grout mixture for joints 1/8 inch (3 mm) and narrower.
2. Sanded grout mixture for joints wider than 1/8 inch (3 mm).

D. High-Performance Cement Grout: ANSI A118.7, packaged.

1. Unsanded grout mix for joints 1/8 inch (3 mm) and narrower.
2. Sanded grout mix for joints wider than 1/8 inch (3 mm).

2.12 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.

C. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; 0.040-inch (1.01-mm) nominal thickness.

2.13 ACCESSORIES

A. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

B. Cleavage Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick; or unperforated asphalt felt, ASTM D226/D226M, Type I (No. 15).

C. Reinforcing Wire: Galvanized, welded, 0.062-inch- (1.57-mm-) diameter wire; 2-by-2-inch (50-by-50-mm) mesh; comply with ASTM A1064/A1064M, except for minimum wire size.

D. Divider Strips and Edging: Metal or combination of metal and PVC or neoprene base, designed specifically for flooring applications, in longest lengths available, and as follows:

1. Exposed-Edge Material: As directed.
2. Cross-Section Profile: As directed.
3. Height: Match stone thickness or Equal to stone thickness plus depth of setting bed.
4. Exposed-Edge Width: As directed.
5. Control-Joint Filler: Neoprene.

E. Abrasive Inserts for Stair Treads: Abrasive strips consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder, fabricated for installing in routed grooves of stair treads to provide slip resistance. Provide epoxy-resin installation adhesive compatible with inserts.

1. Width: 1/4 inch (6.4 mm)
2. Depth: 1/2 inch (12.7 mm)
3. Length: 4 inches (100 mm)

Retain "Cork Joint Filler" Paragraph below if required for joints in exterior flooring or for locations where exterior stone flooring abuts curbs, vertical surfaces, or other paving types.

F. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.

G. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and by sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

H. Floor Sealer: Colorless, slip- and stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.14 MORTAR AND GROUT MIXES

A. Mortar: Comply with referenced standards and with manufacturers' written instructions to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures unless otherwise indicated. Do not use calcium chloride.
2. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Add only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired

consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Portland Cement-Lime Setting Mortar: ASTM C270, Proportion Specification, Type N or Type S, Type N for interior applications and Type S for exterior applications.

C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions and to produce a stiff mixture with a moist surface when bed is ready to receive stone.

D. Mortar-Bed Bond Coat: Mix neat cement and water or latex additive to a creamy consistency.

E. Cement-Paste Bond Coat: Mix either neat cement or cement and sand with water to a consistency similar to that of thick cream.

F. Latex-Modified Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

G. Pointing Mortar: Comply with requirements indicated above for setting mortar, including type and the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

H. Joint Grout: Comply with mixing requirements in referenced ANSI standards and with manufacturer's written instructions.

2.15 STONE FABRICATION

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

B. Cut stone to produce pieces of thickness, size, and shape indicated.

1. Stone Thickness: As directed.
2. Stone Edges: As directed.
3. Joint Width: As directed.

C. Pattern Arrangement: Fabricate and arrange stone units with veining and other natural markings to comply with the following requirements:

1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
2. Arrange units with veining as directed or in blend pattern.

D. Fabricate stone thresholds in sizes and profiles as indicated or required to provide transition between adjacent floor finishes.

E. Fabricate stone stair treads in sizes and profiles indicated. Rout grooves into treads to receive abrasive strips and install strips to comply with manufacturer's written instructions. Cut grooves about 1/8 inch (3 mm) wide by 1/16 inch (1.5 mm) deep in stair treads as indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Vacuum or Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

B. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

C. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

D. Before setting stone, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials.

3.2 INSTALLATION, GENERAL

A. Do necessary field cutting as stone is set. Cut lines straight and true, and finish field-cut edges to match shop-cut edges.

1. Use power saws with diamond blades to cut stone, except for stone that is specified to have rough-split edges.

B. Scribe and field cut stone as necessary to fit at obstructions. Produce neat joints of size specified or indicated.

C. Provide control and expansion joints of widths and at locations indicated. Keep control and expansion joints free of mortar, grout, and other rigid materials.

3.3 INSTALLATION TOLERANCES

A. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

B. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum from level or slope indicated.

C. Variation in Plane between Adjacent Units (Lipping): Do not exceed 1/32-inch (0.8-mm) difference between planes of adjacent units.

3.4 INSTALLATION OF STONE BONDED TO CONCRETE

A. Saturate concrete with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat to damp concrete and broom to provide an even coating that completely covers the concrete. Do not exceed 1/16-inch (1.5-mm) thickness. Limit area of mortar-bed bond coat to avoid its drying out before placing setting bed.

C. Apply mortar bed immediately after applying mortar-bed bond coat. Spread, tamp, and screed to uniform thickness at elevations required for setting stone to finished elevations indicated.

D. Mix and place only that amount of mortar bed that can be covered with stone before initial set. Cut back, bevel edge, and discard material that has reached initial set before stone can be placed.

E. Place stone before initial set of mortar occurs. Immediately before placing stone on setting bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each stone unit.

F. Tamp and beat stone with a wooden block or rubber mallet to obtain full contact with mortar bed and to bring finished surfaces within indicated tolerances. Set each unit in a single operation before initial set of mortar; do not return to areas already set and disturb stone for purposes of realigning finished surfaces or adjusting joints.

G. Rake out joints to depth required to receive grout or pointing mortar as units are set.

H. Point joints after setting. Fill full with mortar type and color indicated. Tool joints flat, uniform, and smooth, without visible voids.

3.5 INSTALLATION OF STONE OVER CLEAVAGE MEMBRANE OR WATERPROOFING

A. Place cleavage membrane over substrates indicated to receive stone, lapped at least 4 inches (100 mm) at joints.

B. See waterproofing Section for installation of waterproofing and protection board.

1. Provide cork joint filler, where indicated, at waterproofing that is turned up on vertical surfaces.

C. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions.

D. Place reinforcing wire fabric over as directed, lapped at least one full mesh at joints and supported so mesh becomes embedded in middle of mortar bed. Hold edges back from vertical surfaces and control and expansion joints about 1/2 inch (13 mm).

E. Place mortar bed over as directed, with reinforcing wire fabric fully embedded in middle of mortar bed. Spread, tamp, and screed to uniform thickness at elevations required for setting stone to finished elevations indicated.

F. Mix and place only that amount of mortar bed that can be covered with stone before initial set. Cut back, bevel edge, and discard material that has reached initial set before stone can be placed.

G. Place stone before initial set of mortar occurs. Immediately before placing stone on setting bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each stone unit.

H. Tamp and beat stone with a wooden block or rubber mallet to obtain full contact with mortar bed and to bring finished surfaces within indicated tolerances. Set each unit in a single operation before initial set of mortar; do not return to areas already set and disturb stone for purposes of realigning finished surfaces or adjusting joints.

I. Rake out joints to depth required to receive grout or pointing mortar as units are set.

J. Point joints after setting. Fill full with mortar type and color indicated. Tool joints flat, uniform, and smooth, without visible voids.

3.6 STONE THRESHOLD INSTALLATION

A. At locations adjacent to stone flooring, install stone thresholds in same type of setting bed as abutting stone flooring unless otherwise indicated.

1. Set thresholds in thinset mortar to comply with ANSI A108.5 at locations where mortar bed would otherwise be exposed above other adjacent flooring.

B. At locations not adjacent to stone flooring, install stone thresholds in thinset mortar to comply with ANSI A108.5 or water-cleanable epoxy adhesive to comply with ANSI A108.4.

3.7 STONE STAIR TREAD AND RISER INSTALLATION

A. Install stone stair treads and risers to comply with "Installation of Stone Bonded to Concrete" Article.

B. Install stone stair treads and risers in thinset mortar to comply with ANSI A108.5 or water-cleanable epoxy adhesive to comply with ANSI A108.4.

3.8 GROUTING

A. Grout stone joints to comply with ANSI A108.10 and with manufacturer's written instructions.

1. Do not use sanded grout for polished stone.
2. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining stone and other surfaces. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free of drying cracks.

3.9 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stonework as work progresses. Remove mortar fins and smears or grout smears before tooling joints.

B. Clean stonework after setting and pointing or grouting are complete. Use procedures recommended by stone fabricator for application types.

C. Apply sealer to cleaned stonework according to sealer manufacturer's written instructions.

3.10 PROTECTION

A. Prohibit traffic from installed stone for a minimum of 72 hours.

B. Protect installed stonework during construction with nonstaining kraft paper. Where adjoining areas require construction work access, cover stonework with a minimum of 3/4-inch (20-mm) untreated plywood over nonstaining kraft paper.

END OF SECTION 096340

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Factory-finished wood flooring.
2. Field-finished wood flooring.
3. Sound control underlayment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 QUALITY ASSURANCE – As directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.

1. Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.

B. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.

1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.

C. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

2.2 FIELD-FINISHED WOOD FLOORING

A. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.

1. Grade and Species: As directed.
2. Cut: As directed.
3. Thickness: 25/32 inch (20 mm) or 3/4 inch (19 mm) and as directed.
4. Face Width: As directed.
5. Lengths: As directed.
6. Simulated Wood Pegs: Contrasting wood pegs at ends of flooring pieces.

B. Engineered-Wood Flooring: HPVA EF, meeting requirements for composite wood products.

1. Species: As directed.
2. Grade: As directed.
3. Thickness: 1/2 inch (13 mm) or 3/8 inch (10 mm).
4. Construction: Five or Three ply as directed.
5. Face Width: 2-1/4 inches (57 mm) or 3 inches (76 mm).
6. Length: Manufacturer's standard.

C. Urethane Finish System: Complete solvent-based, oil-modified or water-based system of compatible components that is recommended by finish manufacturer for application indicated.

1. Stain: Penetrating and nonfading type.

    a. Color: As directed.

2. Floor Sealer: Pliable, penetrating type.
3. Finish Coats: Formulated for multicoat application on wood flooring.

D. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.3 FACTORY-FINISHED WOOD FLOORING

A. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.

1. Species: As directed.
2. Grade: As directed.
3. Cut: As directed.
4. Thickness: 3/4 inch (19 mm) or 25/32 inch (20 mm), as directed.
5. Face Width: As directed.
6. Lengths: As directed.
7. Edge Style: Square or Beveled (eased), as directed.
8. Finish: UV urethane.

    a. Color: As directed.

B. Engineered-Wood Flooring: HPVA EF, meeting requirements for composite wood products.

1. Species: As directed.
2. Grade: As directed.
3. Thickness: 1/2 inch (13 mm) or 3/8 inch (10 mm), as directed.
4. Construction: Five or Three ply, as directed.
5. Face Width: 2-1/4 inches (57 mm) or 3 inches (76 mm).
6. Length: Manufacturer's standard.
7. Edge Style: Square or Beveled (eased).
8. Finish: UV urethane or Acrylic impregnated.

    a. Color: As directed.

2.4 SOUND CONTROL UNDERLAYMENT

A. Sound Control Underlayment: Sound reducing underlayment consisting of impact-absorbing materials. Minimum Impact Insulation Class (IIC) of 50 or 55 or as directed when tested according to ASTM E492.

1. Material: As directed.
2. Thickness: As directed.

2.5 ACCESSORY MATERIALS

A. Wood Sleepers and Subfloor: As specified in Section 061000 "Rough Carpentry" and Section 061600 "Sheathing."

B. Wood Underlayment: As specified in Section 061600 "Sheathing."

C. Vapor Retarder: ASTM D4397, polyethylene sheet not less than 6.0 mils (0.15 mm) or 8.0 mils (0.2 mm) thick.

D. Asphalt-Saturated Felt: ASTM D4869/D4869M, Type II.

E. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

F. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

G. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines."

H. Thresholds and Saddles: To match wood flooring. Tapered on each side.

I. Reducer Strips: To match wood flooring. 2 inches (51 mm) wide, tapered, and in thickness required to match height of flooring.

J. Cork Expansion Strip: Composition cork strip.

K. Feature Strips: 2-inch- (51-mm-) wide, square-edged walnut strips furnished in lengths as long as practical and in thickness to match wood flooring.

L. Wood Air Vents and Grilles: To match wood flooring and in sizes and design indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) or 4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 80 or 75, as directed percent relative humidity level measurement.
    c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines", Retain "Wood Sleepers and Subfloor" and "Wood Underlayment" paragraphs below if required.

B. Wood Sleepers and Subfloor: Install according to requirements in Section 061000 "Rough Carpentry" and Section 061600 "Sheathing."

C. Wood Underlayment: Install according to requirements in Section 061600 "Sheathing."

D. Provide expansion space at walls and other obstructions and terminations of flooring as directed.

E. Vapor Retarder: Comply with the following for vapor retarder installation:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
2. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
3. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.

F. Sound Control Underlayment: Install over vapor retarder according to manufacturer's written instructions.

G. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

1. Plank Flooring: For flooring of face width more than 3 inches (76 mm):

a. Hardwood: Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
b. Softwood: Install no fewer than two countersunk nails at each end of each piece, spaced not more than 16 inches (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

H. Engineered-Wood Flooring: As directed.

3.4 FIELD FINISHING

A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that are noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.

1. Comply with applicable recommendations in NWFA's "Installation Guidelines."

B. Fill open-grained hardwood.

C. Fill and repair wood flooring defects.

D. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats or a directed.

1. Apply stains to achieve an even color distribution matching approved Samples.
2. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.

E. Cover wood flooring before finishing.

F. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.5 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 096466 - WOOD ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes wood athletic flooring.

1.3 COORDINATION

A. Coordinate layout and installation of slab depressions to accommodate layout and height of wood athletic flooring assembly.

B. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each type of floor assembly, include the following:

1. Plans, sections, and attachment details.
2. Details of concrete-slab depressions.
3. Locations of different grades of wood flooring.
4. Expansion provisions and trim details.
5. Layout, colors, widths, and dimensions of game lines and markers.
6. Locations of floor inserts for athletic equipment installed through flooring assembly.

D. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual that has been approved by MFMA as an accredited Installer according to the MFMA Accreditation Program.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 SYSTEM DESCRIPTION

A. System Type: As directed.

B. Overall System Height: As directed.

2.3 PERFORMANCE REQUIREMENTS

2.4 FLOORING MATERIALS

A. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.

1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.

B. Random-Length Strip Flooring: Northern hard maple (Acer saccharum), kiln dried, random length, tongue and groove, and end matched.

1. Grade: MFMA-RL – As directed.

a. Exception: For areas under stacked portion of telescoping bleachers that are normally concealed from view, provide Third and Better Grade.

2. Cut: Edge or Flat.
3. Thickness: 25/32 inch (20 mm) or 33/32 inch (26 mm), as directed.
4. Face Width: 2-1/4 inches (57 mm) or 1-1/2 inches (38 mm), as directed.

2.5 SUBFLOOR MATERIALS

A. Board Underlayment: Nominal 1-by-6-inch (25-by-150-mm) graded boards; of SPIB No. 2 Southern pine, WCLIB Construction grade (any species), or WWPA No. 3 (any species), dried to 15 percent moisture content.

B. Plywood Underlayment: APA rated, C-D plugged, exterior glue, tongue and groove, 15/32 inch (12 mm) or 23/32 inch (18 mm) thick.

C. Wood Sleepers: Standard grade; 48 inches (1200 mm) long; kiln-dried Eastern hemlock, fir, pine, or spruce.

1. Size: Nominal 2 by 3 inches (50 by 75 mm) or 2 by 4 inches (50 by 100 mm).
2. Sleeper Anchors: Manufacturer's standard drive pins recommended by anchor manufacturer to achieve minimum 900-lbf (4000-N) pullout strength in 3000-psi (20.7-MPa) concrete.
3. Sleeper Shims: In size and type recommended in writing by flooring manufacturer for application indicated.
4. Asphalt Primer: ASTM D41/D41M.
5. Asphalt Mastic: ASTM D312, Type I, cold-applied dead-level asphalt or Type III, hot-applied steep asphalt, as recommended in writing by manufacturer.

D. Channels: As directed.

1. Channel Anchors: Manufacturer's standard, but not less than modified steel drive pins recommended by anchor manufacturer to achieve minimum 900-lbf (4000-N) pullout strength.
2. Clips: As directed.

E. Resilient Pads: With air voids for resiliency and installed at manufacturer's standard spacing for product designation indicated above.

1. Type: As directed.
2. Material: As directed.
3. Thickness: As directed.

F. Resilient Underlayment: Flexible, multicellular, closed-cell, expanded polyethylene-foam sheet; nominal 2-lb/cu. ft. (32-kg/cu. m) density.

1. Thickness: As directed.

2.6 FINISHES

A. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.

1. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
2. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.

    a. Type: MFMA Group 3, Gymnasium-Type Surface Finishes or MFMA Group 5, Water-Based Finishes or as directed. .

3. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.

2.7 ACCESSORIES

A. Vapor Retarder: ASTM D4397, polyethylene sheet not less than 6 mils (0.15 mm) thick.

B. Resilient Wall Base: Molded, vented, rubber or vinyl cove base; 4 by 3 by 48 inches (100 by 75 by 1200 mm); with pre-molded outside corners.

1. Color: Black or Brown, as directed.

C. Wood Wall Base: Nominal 1-by-3-inch (25-by-75-mm) wood base or Built-up wood base matching species, grade, and cut of wood flooring as directed.

D. Thresholds: As specified in Section 087100 "Door Hardware".

E. Fasteners: Type and size recommended by manufacturer, but not less than those recommended by MFMA for application indicated.

F. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood athletic flooring manufacturer.

G. Adhesives: Manufacturer's standard for application as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) as directed and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) or 4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m) in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 80 or 75 percent relative humidity level measurement, as directed.
c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.

2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings including curing compounds and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone; use mechanical methods recommended by manufacturer. Do not use solvents.

B. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with wood athletic flooring manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.

B. Pattern: Lay flooring parallel with long dimension of space to be floored unless otherwise indicated.

C. Expansion Spaces: Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.

1. Cover expansion spaces with base molding, trim, and saddles, as indicated on Drawings.

D. Vapor Retarder: Cover entire slab area beneath wood flooring. Install with joints lapped a minimum of 6 inches (150 mm) and sealed.

E. Underlayment: Install perpendicular to direction of flooring, staggering end joints in adjacent rows.

F. Sleepers:

1. Prime entire slab beneath wood floor area with asphalt primer at coverage rate recommended by manufacturer.
2. Install sleepers perpendicular to direction of flooring, staggering end joints a minimum of 24 inches (610 mm) or as directed.
3. Space as directed.
4. Shim and level sleepers and install anchors at spacing recommended by manufacturer, but not less than 30 inches (760 mm) o.c.
5. Pour asphalt mastic to 1/8 inch (3 mm) above the level of shims.
6. Anchor predrilled sleepers through resilient pads.

G. Channels: Anchor channels to substrate according to manufacturer's written instructions.

1. Install wood strip flooring across channels.
2. Insert steel clip at each intersection of a flooring strip with a channel.

H. Strip Flooring: Mechanically fasten perpendicular to supports.

I. Installation Tolerances: 1/8 inch in 10 feet (3 mm in 3 m) of variance from level.

3.4 SANDING AND FINISHING

A. Allow installed flooring to acclimate to ambient conditions before sanding.

B. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."

C. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.

D. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide no fewer than four coats total and no fewer than two finish coats, as directed.

1. Water-Based Finishes: Use finishing methods recommended by finish manufacturer to reduce grain raise and sidebonding effect.
2. Game-Line and Marker Paint: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.

    a. Mask flooring at game line and markers, apply paint to produce lines and markers with sharp edges.
    b. Where game lines cross, break minor game line at intersection; do not overlap lines.
    c. Apply game lines and markers in widths and colors as directed.
    d. Apply finish coats after game-line and marker paint is fully cured.

E. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.

1. Do not cover flooring after finishing until finish reaches full cure and not before seven days after applying last finish coat.
2. Do not move heavy and sharp objects directly over flooring. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096466

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Thermoplastic-rubber base.
3. Vinyl base.
4. Rubber stair accessories.
5. Vinyl stair accessories.
6. Rubber molding accessories.
7. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 THERMOSET-RUBBER BASE

A. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: As directed.
b. Style B, Cove: As directed.
c. Style C, Butt to: As directed.

B. Thickness: 0.125 inch (3.2 mm).

C. Height: As directed.

D. Lengths: As directed.

E. Outside Corners: As directed.

F. Inside Corners: As directed.

G. Colors: As directed.

2.3 THERMOPLASTIC-RUBBER BASE: As directed.

A. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous) or II (layered).
2. Style and Location:

a. Style A, Straight: As directed.
b. Style B, Cove: As directed.
c. Style C, Butt to: As directed.
d. Style D, Sculptured: As directed.

1) Profile: As directed. indicated

B. Thickness: 0.125 inch (3.2 mm).

C. Height: As directed.

D. Lengths: As directed.

E. Outside Corners: As directed.

F. Inside Corners: As directed.

G. Colors: As directed.

2.4 VINYL BASE

A. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous) or II (layered).
2. Style and Location:

a. Style A, Straight: As directed.
b. Style B, Cove: As directed.

B. Minimum Thickness: 0.125 inch (3.2 mm) or 0.080 inch (2.0 mm).

C. Height: As directed. As directed.

D. Lengths: As directed.

E. Outside Corners: As directed.

F. Inside Corners: As directed.

G. Colors and Patterns: As directed.

2.5 RUBBER STAIR ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Stair Treads: ASTM F2169.

1. Type: TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
2. Class: 1 (smooth, flat) or 2 (pattern; embossed, grooved, or ribbed).
3. Group: 1 (embedded abrasive strips) or 2 (with contrasting color for the visually impaired).
4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees. Square or Round as directed.
5. Nosing Height: As directed.
6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
7. Size: Lengths and depths to fit each stair tread in one piece or one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
8. Integral Risers: Smooth, flat; in height that fully covers substrate.

C. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Style: Coved toe, 7 inches (178 mm) high by length matching treads or Toeless, by length matching treads.
2. Thickness: 0.125 inch (3.2 mm), as directed.

D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.

1. Thickness: 0.125 inch (3.2 mm) or 0.080 inch (2.0 mm) or as directed.

E. Landing Tile: Matching treads; as directed.

F. Locations: Provide rubber stair accessories in areas indicated.

G. Colors and Patterns: As directed.

2.6 VINYL STAIR ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Stair Treads: ASTM F2169, Type TV (vinyl, thermoplastic).

1. Class: 1 (smooth, flat) or 2 (pattern; embossed, grooved, or ribbed).
2. Group: 1 (embedded abrasive strips) or 2 (with contrasting color for the visually impaired).
3. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees. Square or Round, as directed
4. Nosing Height: As directed.
5. Thickness: 1/4 inch (6 mm) and tapered to back edge.
6. Size: Lengths and depths to fit each stair tread in one piece or one piece for treads exceeding maximum lengths manufactured, in equal-length units.
7. Integral Risers: Smooth, flat; in height that fully covers substrate.

C. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Style: Coved toe, 7 inches (178 mm) high by length matching treads or Toeless, by length matching treads.
2. Thickness: 0.125 inch (3.2 mm) or 0.080 inch (2.0 mm), as directed.

D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.

1. Thickness: 0.125 inch (3.2 mm) or 0.080 inch (2.0 mm), as directed.

E. Landing Tile: Matching treads; as directed.

F. Locations: Provide vinyl stair accessories in areas indicated.

G. Colors and Patterns: As directed.

2.7 RUBBER MOLDING ACCESSORY

A. Description: Rubber, as directed.

B. Profile and Dimensions: As directed.

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: As directed.

2.8 VINYL MOLDING ACCESSORY

A. Description: Vinyl, as directed.

B. Profile and Dimensions: As directed.

C. Locations: Provide vinyl molding accessories in areas indicated.

D. Colors and Patterns: As directed.

2.9 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 or 10 pH, as directed.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) (as directed), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, or as directed.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Miter or cope corners to minimize open joints, as directed.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.

3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply coat(s) as directed.

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Unbacked vinyl sheet flooring.
2. Vinyl sheet flooring with backing.
3. Unbacked rubber sheet flooring.
4. Rubber sheet flooring with backing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color, texture, and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 UNBACKED VINYL SHEET FLOORING

A. Product Standard: ASTM F1913.

B. Thickness: 0.080 inch (2.0 mm).

C. Wearing Surface: Smooth or Embossed.

D. Sheet Width: 6 feet (1.8 m) or 6.6 feet (2.0 m), as directed.

E. Seamless-Installation Method: Heat welded or Chemically bonded.

F. Colors and Patterns: As directed.

2.3 VINYL SHEET FLOORING WITH BACKING

A. Product Standard: ASTM F1303.

1. Type (Binder Content): Type I, minimum binder content of 90 percent or Type II, minimum binder content of 34 percent.
2. Wear-Layer Thickness: Grade 1.
3. Overall Thickness: As directed.
4. Interlayer Material: Foamed plastic or None.
5. Backing Class: As directed.

B. Wearing Surface: As directed.

C. Sheet Width: As directed.

D. Seamless-Installation Method: Heat welded as Chemically bonded.

E. Colors and Patterns: As directed.

2.4 UNBACKED RUBBER SHEET FLOORING

A. Product Standard: ASTM F1859.

1. Type: Type I, homogeneous rubber sheet floor covering or Type II, heterogeneous (layered) rubber sheet floor covering.
2. Thickness: As directed.
3. Hardness: Not less than required by ASTM F1859 or Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.

B. Wearing Surface: As directed.

1. Molded-Pattern Figure: Raised discs or Raised squares.

C. Sheet Width: As directed.

D. Seamless-Installation Method: Heat welded or Chemically bonded.

E. Colors and Patterns: As directed.

2.5 RUBBER SHEET FLOORING WITH BACKING

A. Product Standard: ASTM F1860.

1. Type: Type I, homogeneous rubber sheet floor covering with backing or Type II, layered rubber sheet floor covering with backing.
2. Wear-Layer Thickness: As directed.
3. Overall Thickness: As directed.
4. Interlayer Material: As directed.
5. Backing: Fibrous or Foamed rubber.
6. Hardness: Not less than required by ASTM F1860 or Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.

B. Wearing Surface: Smooth.

C. Sheet Width: As standard with manufacturer or 3.3 feet (1.0 m), as directed.

D. Seamless-Installation Method: Heat welded or Chemically bonded.

E. Colors and Patterns: As directed.

2.6 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

    a. Colors: As directed.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch (25-mm) radius provided or approved by resilient sheet flooring manufacturer.
2. Cap Strip: Square metal, vinyl, or rubber cap or Tapered vinyl cap, as directed, provided or approved by resilient sheet flooring manufacturer.
3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 or 10 pH or as directed.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, as directed.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.2 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches (152 mm) to dimension indicated up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

K. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply coat(s) as directed.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.
2. Rubber floor tile.
3. Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE

A. Tile Standard: ASTM F1700.

1. Class: As directed.

B. Thickness: As directed.

C. Size: As directed.

D. Colors and Patterns: As directed.

2.3 RUBBER FLOOR TILE

A. Tile Standard: ASTM F1344, as directed.

B. Hardness: As directed.

C. Wearing Surface: As directed.

1. Molded-Pattern Figure: Raised discs or Raised squares.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm) or 24 by 24 inches (610 by 610 mm).

F. Colors and Patterns: As directed.

2.4 VINYL COMPOSITION FLOOR TILE

A. Tile Standard: ASTM F1066, as directed.

B. Wearing Surface: Smooth or Embossed.

C. Thickness: 0.125 inch (3.2 mm).

D. Size: 12 by 12 inches (305 by 305 mm).

E. Colors and Patterns: As directed.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 or 10 pH, as directed.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, as directed.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles as directed.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles as directed.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply coat(s) as directed.

END OF SECTION 096519

SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Static-dissipative, solid vinyl floor tile, rubber floor tile, vinyl composition floor tile, vinyl sheet floor covering or rubber sheet floor covering as directed.
2. Conductive, solid vinyl floor tile or vinyl sheet floor covering as directed.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each type of static-control resilient flooring.

1. Samples: For each type of static-control resilient flooring.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive static-control resilient flooring.

1. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

B. Close spaces to traffic during static-control resilient flooring installation.

C. Close spaces to traffic for 48 hours after static-control resilient flooring installation.

D. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Static-Dissipative Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F150 with 100-V applied voltage or ESD-STM-7.1 as directed.

    a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.
    b. Average greater than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.

2. Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.25 seconds when tested per FED-STD-101C/4046.1.

B. Conductive Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F150 with 500-V applied voltage, ESD-STM-7.1, NFPA 99, Annex E or UL 779 as directed.

    a. Average greater than 25,000 ohms and less than 1 megohm when test specimens and installed floor coverings are tested surface to surface (point to point).
    b. Average greater than 25,000 ohms with no single measurement less than 10,000 ohms when installed floor coverings are tested surface to ground.

2. Static Generation: Less than 100 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.03 or 0.01 seconds when tested per FED-STD-101C/4046.1 as directed.

C. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS

A. Static-Dissipative, Solid Vinyl Floor Tile: ASTM F1700, Class I (monolithic), Type A (smooth surface).
   1. Thickness: In manufacturer's standard thickness, but not less than 0.08 inch (2.0 mm).
   2. Size: 12 by 12 inches (305 by 305 mm), 24 by 24 inches (610 by 610 mm) or 36 by 36 inches (914 by 914 mm) as directed.
   3. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors as directed.

B. Static-Dissipative Rubber Floor Tile: ASTM F1344; except in manufacturer's standard hardness when tested per ASTM D2240 using Shore, Type A durometer.

   1. Hammered-Surface Textured Floor Tile: Class I-B (homogenous rubber, through-mottled pattern).
      a. Thickness: Not less than 0.09 inch (2.2 mm) or 0.14 inch (3.5 mm) as directed.
      b. Size: 19.7 by 19.7 inches (500 by 500 mm) or 39.4 by 39.4 inches (1000 by 1000 mm) as directed.
      c. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

   2. Smooth or Textured-Surface Floor Tile: Class I-B (homogenous rubber, through-mottled pattern).
      a. Thickness: Not less than 0.08 inch (2.0 mm) or 0.14 inch (3.5 mm) as directed.
      b. Size: 24 by 24 inches (610 by 610 mm) or 39.4 by 39.4 inches (1000 by 1000 mm) as directed.
      c. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

C. Static-Dissipative, Vinyl Composition Floor Tile: ASTM F1066 (vinyl composition floor tile, nonasbestos formulated), Class 2 (through-pattern tile).
   1. Thickness: Not less than 0.125 inch (3.2 mm).
   2. Size: 12 by 12 inches (305 by 305 mm).
   3. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

D. Static-Dissipative, Vinyl Sheet Floor Covering: ASTM F1913 (unbacked) or ASTM F1303, Type II, Grade I, Class B (nonfoamed plastic backing).
   1. Thickness: Not less than 0.08 inch (2.0 mm).
   2. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

E. Static-Dissipative, Rubber Sheet Floor Covering: ASTM F1859, Type I (homogenous).
   1. Wear Surface: Smooth or Slightly textured.
   2. Thickness: Not less than 0.08 inch (2.0 mm) or 0.14 inch (3.5 mm) as directed.
   3. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

2.3 CONDUCTIVE RESILIENT FLOOR COVERINGS

A. Conductive, Solid Vinyl Floor Tile: ASTM F1700, Class I (monolithic), Type A (smooth surface).
   1. Thickness: In manufacturer's standard thickness, but not less than 0.08 inch (2.0 mm).
   2. Size: 12 by 12 inches (305 by 305 mm), 24 by 24 inches (610 by 610 mm) or 36 by 36 inches (914 by 914 mm) as directed.
   3. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors.

B. Conductive, Vinyl Sheet Floor Covering: ASTM F1303, Type II, Grade I, Class B (nonfoamed plastic backing).
   1. Thickness: Manufacturer's standard thickness, but not less than 0.08 inch (2.0 mm).
   2. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from full range of industry colors as directed.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

D. Integral-Flash-Cove Base Accessories:

   1. Cove Strip: 1-inch (25-mm) radius support strip provided or approved by manufacturer.
   2. Cap Strip: Square metal, vinyl, or rubber cap or Tapered vinyl cap provided or approved by manufacturer.
   3. Corners: Metal inside and outside corners and end stops provided or approved by floor-covering manufacturer.

E. Maintenance Floor Tiles: Special floor tiles inscribed "Conductive floor. Do not wax."

F. Floor Polish: Provide protective, static-control liquid floor polish products as recommended by floor-covering manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions and with oversight by manufacturer's representative to ensure adhesion of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare according to ASTM F710 and as recommended by manufacturer. Do not use solvents for cleaning substrates.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.2 INSTALLATION, GENERAL

A. Install static-control resilient flooring according to manufacturer's written instructions and with oversight by manufacturer's representative.

B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings. Extend static-control resilient flooring to center of door openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Integral-Flash-Cove Base: As directed Cove static-control flooring 6 inches (152 mm) or to dimension indicated up vertical surfaces. Support static-control resilient flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.3 FLOOR-TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles square with room axis, at a 45-degree angle with room axis or in pattern indicated as directed.

C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay static-dissipative, vinyl composition floor tiles with grain running in one direction, with grain direction alternating in adjacent floor tiles (basket-weave pattern) or in pattern of colors and sizes indicated.

D. In each space where conductive, solid vinyl floor tile is installed, install maintenance floor tile identifying conductive floor tile in locations approved by Architect.

3.4 SHEET FLOOR-COVERING INSTALLATION

A. Comply with manufacturer's written instructions for installing sheet floor coverings.

B. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting.

C. Lay out sheet floor coverings as follows:

1. Maintain uniformity of sheet floor-covering direction.
2. Minimize number of seams and place them in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor-covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

3.5 FIELD QUALITY CONTROL

A. Testing: As directed Owner will engage or Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.

1. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.
2. Arrange for testing of static-control resilient flooring before and after performing floor polish procedures.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

C. Cover static-control resilient flooring until Substantial Completion.

END OF SECTION 096536

SECTION 096543 - LINOLEUM FLOORING.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Linoleum floor tile.
2. Linoleum sheet flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LINOLEUM FLOOR TILE

A. Linoleum Floor Tile: ASTM F2195, as directed.

1. Nominal Floor Tile Size: As directed.

B. Thickness: 0.08 inch (2.0 mm) or 0.10 inch (2.5 mm).

C. Colors and Patterns: As directed.

2.3 LINOLEUM SHEET FLOORING

A. Linoleum Sheet Flooring: ASTM F2034, Type I, linoleum sheet with backing or Type III, linoleum sheet with special backing.

1. Roll Size: In manufacturer's standard length, but not less than 78 inches (1980 mm) wide.

B. Thickness: As directed.

C. Heat-Welding Bead: For seamless installation, solid-strand product of linoleum flooring manufacturer.

1. Colors: As directed.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch (25.4-mm) radius, provided or approved by manufacturer.
2. Cove-Base Cap Strip: As directed or approved by manufacturer.

E. Colors and Patterns: As directed.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by linoleum flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 or 10 pH, as directed.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement or as directed.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install flooring until materials are the same temperature as space where they are to be installed.

1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing flooring.

B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on

covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

G. Heat-Welded Seams: For seamless installation, comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.3 LINOLEUM FLOOR TILE INSTALLATION

A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay floor tiles as directed.

B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles as directed.

3.4 LINOLEUM SHEET FLOORING INSTALLATION

A. Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out linoleum sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.
5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

C. Integral-Flash-Cove Base: Cove flooring 6 inches (152 mm) to dimension indicated up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

3.5 CLEANING AND PROTECTION

A. Floor Polish: Remove soil, adhesive, and blemishes from linoleum flooring surfaces before applying liquid floor polish.

1. Apply two or three coat(s) as directed.

B. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 096543

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interlocking, rubber floor tile.
2. Rubber floor tile.
3. Rubber sheet flooring.
4. Sheet vinyl flooring.

1.2 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Show installation details and locations of the following:

1. Border tiles.
2. Floor patterns.
3. Layout, colors, widths, and dimensions of game lines and markers.
4. Locations of floor inserts for athletic equipment installed through flooring.
5. Seam locations for sheet flooring.

D. Samples: For each exposed product and for each type, color, and pattern specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 INTERLOCKING, RUBBER FLOOR TILE

A. Description: Athletic flooring consisting of modular rubber tiles with precision cut, interlocking edges, for free-lay installation.

B. Material: Rubber or Recycled-rubber compound as directed.

C. Tile Interlock: Visible or Hidden as directed.

D. Traffic-Surface Texture: Smooth, Nondirectional, stipple texture or Textured as directed.

1. Provide reversible tiles (with traffic-surface texture on both sides).

E. Size: Manufacturer's standard-size square tile or 24 inches (610 mm) square as directed.

F. Thickness: 3/8 inch (9.5 mm), 7/16 inch (11.1 mm), 1/2 inch (13 mm), 9/16 inch (14.3 mm) or 3/4 inch (19 mm) as directed.

G. Weight: Not less than a certain weight per tile as directed.

H. Color and Pattern: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations as directed.

I. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; for use where flooring corners and edges do not abut vertical surfaces.

1. Border Color and Pattern: Matching floor tile, As selected by Architect from manufacturer's full range to contrast with floor tile or As indicated by manufacturer's designations.

2.3 RUBBER FLOOR TILE

A. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.

B. Material: Rubber, Recycled-rubber compound or Rubber wear layer and rubber shock-absorbent layer, vulcanized together as directed.

C. Traffic-Surface Texture: Smooth, Nondirectional, stipple texture or Textured as directed.

D. Size: Manufacturer's standard-size square tile, 18 inches (457 mm) square, 24 inches (610 mm) square or 36 inches (914 mm) square as directed.

E. Thickness: 5/32 inch (4 mm), 1/4 inch (6.4 mm), 3/8 inch (9.5 mm) or 1/2 inch (13 mm) as directed.

F. Weight: Not less than a certain weight per tile as directed.

G. Color and Pattern: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations.

H. Border: Interlocking, beveled-edge tiles, of same material as floor tile; with bevels that transition from thickness of floor tile to surface below it; with straight outside edges; for use where flooring corners and edges do not abut vertical surfaces.

1. Border Color and Pattern: Matching floor tile, As selected by Architect from manufacturer's full range to contrast with floor tile or As indicated by manufacturer's designations.

2.4 RUBBER SHEET FLOORING

A. Description: Rubber athletic flooring provided as rolled goods for adhered installation.

B. Material: Recycled-rubber compound or Rubber wear layer and rubber shock-absorbent layer, vulcanized together as directed.

C. Traffic-Surface Texture: Smooth.

D. Roll Size: Not less than 48 inches (1219 mm) wide by longest length that is practical to minimize splicing during installation.

E. Thickness: 1/4 inch (6.4 mm) or 3/8 inch (9.5 mm) as directed.

F. Color and Pattern: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations.

G. Border: Interlocking, beveled-edge tiles, of same material as sheet flooring; with bevels that transition from thickness of sheet flooring to surface below it; with straight outside edges; for use where flooring corners and edges do not abut vertical surfaces.

1. Border Color and Pattern: Matching sheet flooring, As selected by Architect from manufacturer's full range to contrast with floor tile or As indicated by manufacturer's designations.

2.5 SHEET VINYL FLOORING

A. Description: Sheet vinyl flooring specifically designed for adhered athletic flooring applications.

B. Unbacked Sheet Vinyl Flooring: ASTM F1913, 0.08 inch (2 mm) thick.

1. Separate underlayment pad of bonded recycled rubber and polyurethane particles.

C. Sheet Vinyl Flooring with Backing: ASTM F1303.

1. Type (Binder Content): Type I, minimum binder content of 90 percent or Type II, minimum binder content of 34 percent as directed.
2. Wear-Layer Thickness: Grade 1.
3. Overall Thickness: As directed.
4. Interlayer Material: Foamed plastic or None as directed.
5. Backing Class: Class B (nonfoamed plastic) or Class C (foamed plastic) as directed.

D. Seaming Method: Heat welded or Chemically bonded as directed.

E. Traffic-Surface Texture: Smooth or Embossed as directed.

F. Applied Finish: Factory-applied UV urethane.

G. Roll Size: Not less than 48 inches (1219 mm) wide by longest length that is practical to minimize splicing during installation.

H. Color and Pattern: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations.

2.6 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

C. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) as directed and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.3 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis, at a 45-degree angle or with room axis in pattern indicated as directed.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Tile Matching: Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.

1. Lay tiles with grain running in one direction, with grain direction alternating in adjacent tiles (basket-weave pattern) or in pattern of colors and sizes indicated as directed.

D. Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

E. Free-Lay Tile: Place flooring at locations indicated with units securely interconnected and fully seated on substrate to form a smooth, level surface.

3.4 SHEET FLOORING INSTALLATION

A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (150 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Locate seams according to approved Shop Drawings.

C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
2. Chemically Bonded Seams: Comply with ASTM F693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.

3.5 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers, apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poured-in-place portland cement terrazzo flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is a contractor member of NTMA.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 PORTLAND CEMENT TERRAZZO

A. Portland Cement Terrazzo System: As directed.

1. Underbed Thickness: As directed.
2. Terrazzo Topping Thickness: As directed.

B. Materials:

1. Portland Cement: ASTM C150/C150M, Type 1.

    a. Color for Terrazzo Matrix: As directed.

2. Water: Potable.
3. Sand: ASTM C33/C33M.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M and ASTM C535 for large-size coarse aggregates.
    b. 24-Hour Absorption Rate: Less than 0.75 percent.
    c. Dust Content: Less than 1.0 percent by weight.
5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
6. Underbed Bonding Agent: Neat portland cement paste.
7. Topping Bonding Agent: Neat portland cement paste, or epoxy or acrylic bonding agents formulated for use with monolithic terrazzo.
8. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire 2 by 2 inches (51 by 51 mm) by 0.062 inch (1.57 mm) in diameter, complying with ASTM A1064/A1064M, except for minimum wire size.
9. Isolation Membrane: Polyethylene sheeting, ASTM D2103, Type 13300, 4 mils (0.1 mm) thick; or unperforated asphalt felt, ASTM D226/D226M, Type I (No. 15).

C. Mixes:

1. Underbed Mix: One part portland cement to four parts sand and sufficient water to provide workability at as low a slump as possible.
2. Terrazzo Topping Mix: One 94-lb (42.6-kg) bag of portland cement per 200 lb (90.7 kg) of aggregate, matrix pigment if required by mix color, and sufficient water to produce a workable mix.

    a. Mix Color and Pattern: As directed.

2.3 STRIP MATERIALS

A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

1. Material: White-zinc alloy or Brass.
2. Depth: As directed.
3. Width: As directed.

B. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

1. Base-Section Material: White-zinc alloy or Galvanized steel.
2. Top-Section Material: As directed.
3. Depth: As directed.
4. Top-Section Width: As directed.

C. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.

1. Material: As directed.
2. Top-Section Width: As directed.

D. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

E. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

F. Abrasive Strips: As directed, abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.

1. Width: 1/2 inch (12.7 mm).
2. Depth: As required by terrazzo thickness.
3. Length: 4 inches (100 mm) less than stair width, as indicated.
4. Color: As directed.

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Recommended by manufacturer for this use.
1.

B. Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; or cork; in width indicated or minimum 1/2 inch (12.7 mm) wide.

E. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's written recommendations for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.

B. Comply with NTMA's written recommendations for terrazzo and accessory installation.

C. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

D. Underbed:

1. Comply with NTMA's written recommendations for underbed installation.
2. Sand-Cushion Portland Cement Terrazzo:

a. Cover entire surface to receive terrazzo with dusting of sand.
b. Install isolation membrane over sand, overlapping ends and edges a minimum of 3 inches (75 mm).
c. Install welded-wire reinforcement, overlapping at edges and ends at least two squares. Stop mesh a minimum of 1 inch (25 mm) short of expansion joints.

3. Bonded Portland Cement Terrazzo:

a. Saturate structural concrete substrate with water, and slush and broom with underbed bonding agent.

4. Place underbed and screed to elevation indicated below finished floor elevation.

E. Strip Materials:

1. Divider and Control-Joint Strips:

    a. Locate divider strips directly over breaks and control joints in concrete slabs, in locations indicated.
    b. Install control-joint strips back to back and directly above concrete-slab control joints or in locations indicated.

        1) Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.

    c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch (1.6 mm) higher than terrazzo surface.

3.2 POURED-IN-PLACE TERRAZZO INSTALLATION

A. Underbed Preparation:

1. Sand-Cushion Portland Cement Terrazzo: Saturate underbed with water to produce a cement slurry.
2. Bonded Portland Cement Terrazzo: Dampen underbed with water.

B. Monolithic Portland Cement Terrazzo: Apply topping bonding agent on concrete substrate.

C. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips. Seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Roll and compact surface until excess cement and water have been extracted.

1. Portland Cement Terrazzo: Trowel to a dense, uniform, flat surface disclosing lines of divider strips.

D. Portland Cement Terrazzo Stairs: Install and finish stairs at the same time that adjacent flooring is installed.

E. Portland Cement Terrazzo Base: Install and finish base at the same time that adjacent flooring is installed.

F. Portland Cement Terrazzo Finishing: Cover terrazzo topping with moisture-retaining cover and cure until topping develops sufficient strength to prevent lifting or pulling of aggregate during grinding.

1. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond plates.
2. Grouting: After rough grinding, clean terrazzo topping with water and rinse away residue. Remove excess rinse water, apply matrix mix to grout surface, and fill voids. After

grouting, cover surface with moisture-retaining cover to cure grout until ready for fine grinding.

3. Fine Grinding and Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 80 or 120 -grit stones or with comparable diamond abrasives until grout is removed from surface.

G. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.3 CLEANING AND PROTECTION

A. Terrazzo Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to both NTMA's and manufacturer's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

END OF SECTION 096613

SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes thin-set, epoxy-resin terrazzo flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material certificates.

C. Preinstallation moisture-testing reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage an installer who is a contractor member of NTMA.
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.

B. Mix Color and Pattern: As selected by Architect from manufacturer's full range, As selected by Architect from NTMA's "Terrazzo Color Palette" EI Series, As selected by Architect from NTMA's "Terrazzo Color Palette" EII Series, As selected by Architect from NTMA's "Terrazzo Color Palette" EIII Series, As selected by Architect from NTMA's "Terrazzo Color Palette" EIV Series, Match Architect's sample or Match existing.

C. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D412.
    a. Reinforcement: Fiberglass scrim.
3. Primer: Manufacturer's product recommended for substrate and use indicated.
4. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
5. Finishing Grout: Resin based.

2.3 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Material: As indicated, White-zinc alloy, Brass, Aluminum or Plastic, in color selected from full range of industry colors.
2. Top Width: As indicated, 1/8 inch (3.2 mm) or 1/4 inch (6.4 mm) as directed.

B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.

1. Bottom-Section Material: As indicated, Galvanized steel or Matching top-section material as directed.
2. Top-Section Material: As indicated, White-zinc alloy, Brass, Aluminum or Plastic, in color selected from full range of industry colors.

3. Top-Section Width: As indicated, 1/8 inch (3.2 mm), 1/4 inch (6.4 mm), 3/8 inch (9.5 mm) or 1/2 inch (12.7 mm).

C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

D. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.
3. Nosings for terrazzo stair treads and landings.

E. Abrasive Strips: As directed Three-line, Two-line, One-line or Abrasive nosing strip and two-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.

1. Width: 1/2 inch (12.7 mm).
2. Depth: As required by terrazzo thickness.
3. Length: 4 inches (100 mm) less than stair width or As indicated.
4. Color: As selected by Architect from full range of industry colors.

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

B. Anchoring Devices: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer, Acrylic, Urethane, Chemical-resistant epoxy or Water based as directed.

1. Surface Friction: Not less than 0.6 according to ASTM D2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

    a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

D. Preinstallation Moisture Testing:

1. Testing Agency: Owner will engage or Engage a qualified testing agency to perform tests.
2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
    b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.

3. Proceed with terrazzo installation only after concrete substrates pass moisture testing or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing.

E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.

1. Install on concrete substrates that incorporate lightweight aggregates.
2. Install concrete substrates that fail preinstallation moisture testing.

F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane at substrate cracks to produce full substrate coverage in areas to receive terrazzo.
3. Reinforce membrane with fiberglass scrim.

G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.2 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Strip Materials:

1. Divider and Control-Joint Strips:

a. Locate divider strips in locations indicated.
b. Install control-joint strips back to back and directly above concrete-slab control joints or in locations indicated.
c. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation or in locations indicated.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch (1.6 mm) higher than terrazzo surface.

C. Apply primer to terrazzo substrates according to manufacturer's written instructions.

D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.

1. Installed Thickness: 1/4 inch (6.4 mm) or 3/8 inch (9.5 mm) or As indicated on Drawings nominal.
2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.

c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. As directed Grind with 80 or 120-grit stones or with comparable diamond abrasives until grout is removed from surface.

3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.

F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

G. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

H. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

I. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

END OF SECTION 096623

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes resinous flooring systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing according to ASTM D635.

2.2 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. System Characteristics:

1. Color and Pattern: As directed.
2. Wearing Surface: As directed.
3. Overall System Thickness: As directed.
4. Federal Agency Approvals: USDA or FDA approved for food-processing environments.

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

D. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer.

a. Provide fiberglass scrim embedded in reinforcing membrane.

E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

F. Body Coats:
1. Resin: Epoxy.
2. Formulation Description: As directed.
3. Type: Clear or Pigmented.
4. Application Method: As directed.
5. Number of Coats: One or Two.
6. Thickness of Coats: As directed.
7. Aggregates: As directed.

G. Topcoats: Sealing or finish coats.
1. Resin: Epoxy.
2. Formulation Description: As directed.
3. Type: Clear or Pigmented.
4. Number of Coats: One or Two.
5. Thickness of Coats: As directed.
6. Finish: Matte or Gloss.

H. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: Minimum according to ASTM C579, as directed.
2. Tensile Strength: Minimum according to ASTM C307, as directed.
3. Flexural Modulus of Elasticity: Minimum according to ASTM C580, as directed.
4. Water Absorption: percent (as directed) maximum according to ASTM C413.

I. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D1308 for 50 percent immersion or ASTM D543, Procedure A, for immersion or ASTM C267 for immersion in the following reagents for no fewer than seven days:

1. As directed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) or 4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m) of slab area in 24 hours.
   b. Plastic Sheet Test: ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates.
   c. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, as directed.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks or entire substrate surface.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions. Round internal and external corners.

1. Integral Cove Base: 4 inches (100 mm) high.

E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

G. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.

H. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

I. Protect resinous flooring from damage and wear during the remainder of construction period.

END OF SECTION 096723

SECTION 096766 - FLUID-APPLIED ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyurethane flooring, fluid applied directly on substrates.
2. Polyurethane flooring, fluid applied over base mats.

1.2 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: For flooring. Show installation details including layout, colors, widths, and dimensions of game lines and markers and locations of athletic equipment floor inserts.

D. Samples: For each exposed product and for each color, gloss, and texture of floor specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is approved, trained, or certified by fluid-applied athletic flooring manufacturer.

PART 2 - PRODUCTS

2.1 DIRECT-APPLIED FLOORING

A. Description: Fluid-applied athletic flooring system consisting of primer and polyurethane body and topcoats applied directly to substrate.

B. Materials:

1. Primer: Manufacturer's primer recommended for substrate indicated.
2. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.
3. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.

C. Finishes:

1. Color: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations.
2. Surface Texture: Manufacturer's standard.

2.2 FLOORING APPLIED OVER BASE MATS

A. Description: Fluid-applied athletic flooring system consisting of resilient base mat adhered to substrate, base mat sealer, and fluid-applied polyurethane body and topcoats.

B. Base Mat: Manufacturer's standard base mats of granulated recycled rubber in polyurethane binder.

1. Thickness: 5/32 inch (4 mm), 1/4 inch (6 mm), 9/32 inch (7 mm), 11/32 inch (9 mm) or 15/32 inch (12 mm) as directed.

C. Base-Mat Adhesive: Manufacturer's standard two-component polyurethane.

D. Base-Mat Sealer: Manufacturer's standard two-component polyurethane compound formulated for sealing base mat.

E. Body Coat(s): Two-component, self-leveling, pigmented, polyurethane containing no rubber fillers and no mercury.

1. Topcoat (Finish Coat): Manufacturer's standard pigmented polyurethane.

F. Finishes:

1. Color: As selected by Architect from manufacturer's full range or As indicated by manufacturer's designations.
2. Surface Texture: Manufacturer's standard.

2.3 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete Substrates: Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m) as directed, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

B. Remove substrate coatings and other substances that are incompatible with flooring system components and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

D. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring, according to manufacturer's written instructions.

E. Protect substrate voids and joints to prevent flooring resins from flowing into or leaking through them.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Protect walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.2 FLOORING INSTALLATION, GENERAL

A. Mix and apply flooring components according to manufacturer's written instructions.

1. At substrate expansion, isolation, and other moving joints, install continuous joint of same width through flooring.

3.3 INSTALLATION OF DIRECT-APPLIED FLOORING

A. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

B. Apply body coat(s) and topcoat to produce a uniform, level surface and finish.

3.4 INSTALLATION OF FLOORING APPLIED OVER BASE MATS

A. Adhesively apply resilient base mats to substrate according to manufacturer's written instructions.

1. Do not compress mats when fitting into place. Leave gap of width recommended in writing by manufacturer at butted base-mat sheets, walls, floor openings, athletic equipment inserts, electrical openings, door frames, and other obstructions.
2. Roll base mats to set them into adhesive and eliminate air pockets.
3. Repair ridges at seams, loose areas, and air pockets according to manufacturer's written instructions.

B. Apply seal coat to base mats before applying body coat(s).

C. Smooth ridges and high spots in seal coat before applying body coat(s).

D. Apply body coat(s) and topcoat to produce a uniform surface and finish.

3.5 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.

3.6 PROTECTION

A. Close spaces to traffic for 48 hours, 96 hours or seven days after flooring installation unless manufacturer recommends longer period in writing.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096766

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II or Master II certification level.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Color: As directed.

B. Pattern: As directed.

C. Fiber Content: As directed.

D. Fiber Type: As directed.

E. Pile Characteristic: As directed.

F. Yarn Twist: TPI (TPCM), as directed.

G. Yarn Count: As directed.

H. Density: oz./cu. yd. (g/cu. cm), as directed.

I. Pile Thickness: inches (mm) for finished carpet tile according to ASTM D6859, as directed.

J. Stitches: inch (mm), as directed.

K. Gage: inch (mm), as directed.

L. Surface Pile Weight: oz./sq. yd. (g/sq. m), as directed.

M. Total Weight: oz./sq. yd. (g/sq. m) for finished carpet tile, as directed.

N. Primary Backing/Backcoating: As directed.

O. Secondary Backing: As directed.

P. Backing System: As directed.

Q. Size: As directed.

R. Applied Treatments:

1. Soil-Resistance Treatment: As directed.
2. Antimicrobial Treatment: As directed to protect carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

S. Sustainable Design Requirements:

1. Sustainable Product Certification: Level certification according to ANSI/NSF 140, as directed.

T. Performance Characteristics:

1. Appearance Retention Rating: As directed, minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm or 0.22 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
4. Tuft Bind: Not less than "as directed" according to ASTM D1335.
5. Delamination: Not less than 3.5 lbf/in. (0.6 N/mm) or 4 lbf/in. (0.7 N/mm) according to ASTM D3936.
6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Noise Reduction Coefficient (NRC): As directed, according to ASTM C423.
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after 40 or 60 AFU (AATCC fading units) according to AATCC 16, Option E.
11. Electrostatic Propensity: Less than 3.5 or 2 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, as directed.
    c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

C. Metal Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

D. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.

1. Access Flooring Systems: Verify access floor substrate is compatible with carpet tile and adhesive, if any, and underlayment surface is gaps greater than 1/8 inch (3 mm) and protrusions more than 1/32 inch (0.8 mm).

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As directed.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns, as directed.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tufted carpet.
2. Woven carpet.
3. Carpet cushion.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For carpet installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Types, colors, and locations of insets and borders.
10. Types, colors, and locations of edge, transition, and other accessory strips.
11. Transition details to other flooring materials.
12. Type of carpet cushion.

D. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II or Master II certification level.

1.7 WARRANTY

A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Warranty for Carpet Cushion: Manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUFTED CARPET

A. Color: As directed.

B. Pattern: As directed.

C. Fiber Content: As directed.

D. Fiber Type: As directed.

E. Pile Characteristic: As directed.

F. Yarn Twist: TPI (TPCM), as directed.

G. Yarn Count: As directed.

H. Density: oz./cu. yd. (g/cu. cm), as directed.

I. Pile Thickness: As directed, inches (mm) for finished carpet according to ASTM D6859.

J. Stitches: inch (mm), as directed.

K. Gage: inch (mm), as directed.

L. Face Weight: oz./sq. yd. (g/sq. m), as directed.

M. Total Weight: oz./sq. yd. (g/sq. m) for finished carpet, as directed.

N. Primary Backing: As directed.

O. Secondary Backing: As directed.

P. Backcoating: As directed.

Q. Backing System: As directed.

R. Roll Width: As directed.

S. Applied Treatments:

1. Applied Soil-Resistance Treatment: As directed.
2. Antimicrobial Treatment: As directed.

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

T. Sustainable Design Requirements:

1. Sustainable Product Certification: Level certification according to ANSI/NSF 140, as directed.

U. Performance Characteristics:

1. Appearance Retention Rating: As directed. Minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm or 0.22 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
4. Tuft Bind: Not less than (As directed) according to ASTM D1335.
5. Delamination: Not less than (As directed) according to ASTM D3936.
6. Noise Reduction Coefficient (NRC): According to ASTM C423, as directed.
7. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
8. Colorfastness to Light: Not less than 4 after 40 or 60 AFU (AATCC fading units) according to AATCC 16, Option E.
9. Electrostatic Propensity: Less than 3.5 or 2 kV according to AATCC 134.

2.2 WOVEN CARPET

A. Color: As directed.

B. Pattern: As directed.

C. Fiber Content: As directed.

D. Face Construction: As directed.

E. Pile Characteristic: As directed.

F. Yarn Twist: TPI (TPCM), as directed.

G. Yarn Count: As directed.

H. Density: oz./cu. yd. (g/cu. cm), as directed.

I. Pile Thickness: inches (mm) for finished carpet according to ASTM D6859, as directed.

J. Rows: inch (mm), as directed.

K. Pitch: Number of rows in 27 inches (686 mm), as directed.

L. Face Weight: oz./sq. yd. (g/sq. m), as directed.

M. Total Weight: oz./sq. yd. (g/sq. m) for finished carpet, as directed.

N. Backing: As directed:

1. Chain Warp: As directed.
2. Stuffer Warp: As directed.
3. Shot or Fill Weft: As directed.
4. Backcoating: As directed.

O. Applied Treatments:

1. Applied Soil-Resistance Treatment: As directed.
2. Antimicrobial Treatment: As directed.

    a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

P. Sustainable Design Requirements:

1. Sustainable Product Certification: Level certification according to ANSI/NSF 140, as directed

Q. Performance Characteristics:

1. Appearance Retention Rating: As directed. Minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm or 0.22 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
4. Noise Reduction Coefficient (NRC): According to ASTM C423, as directed.
5. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
6. Colorfastness to Light: Not less than 4 after 40 or 60 AFU (AATCC fading units) according to AATCC 16, Option E.
7. Electrostatic Propensity: Less than 3.5 or 2 kV according to AATCC 134.

2.3 CARPET CUSHION

A. Traffic Classification: CCC, as directed.

B. Fiber Cushion: As directed.

1. Weight: oz./sq. yd. (g/sq. m), as directed.
2. Thickness: inches (mm), as directed plus 5 percent maximum.
3. Density: lb/cu. ft. (kg/cu. m), as directed.

C. Rubber Cushion: As directed.

1. Weight: oz./sq. yd. (g/sq. m), as directed.
2. Thickness: inches (mm), as directed plus 5 percent maximum.
3. Compression Resistance: lb/sq. in. (kg/sq. mm) at 25 or 65 percent according to ASTM D3676, as directed.
4. Density: lb/cu. ft. (kg/cu. m), as directed.

D. Polyurethane-Foam Cushion: As directed.

1. Compression Force Deflection at 65 Percent: lb/sq. in. (kg/sq. mm) of polymer density according to ASTM D3574, as directed.
2. Thickness: inches (mm), as directed.
3. Density: lb/cu. ft. (kg/cu. m) as directed.

E. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm or 0.22 W/sq. cm according to NFPA 253, as directed.
2. Noise Reduction Coefficient (NRC): According to ASTM C423, as directed

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet or carpet cushion manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by as directed.

C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI's "Carpet Installation Standard."

D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) or 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement, as directed
    c. Perform additional moisture tests recommended in writing by adhesive and carpet or adhesive, carpet cushion, and carpet manufacturers. Proceed with installation only after substrates pass testing.

B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

3.2 PREPARATION

A. General: Comply with CRI's "CRI Carpet Installation Standard" and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet or adhesive, carpet, and carpet cushion manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 CARPET INSTALLATION

A. Comply with CRI's "CRI Carpet Installation Standard" and carpet manufacturer's or carpet and carpet cushion manufacturers' written installation instructions for the following:

1. Direct-glue-down installation.
2. Double-glue-down installation.
3. Carpet with attached-cushion installation.
4. Preapplied adhesive installation.

5. Hook-and-loop installation.
6. Stretch-in installation.
7. Stair installation.

B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

1. Stretch-in Carpet Installation: Install carpet cushion seams at 90-degree angle with carpet seams.

C. Install pattern parallel to walls and borders, as directed.

D. Install borders with mitered corner seams.

E. Do not bridge building expansion joints with carpet.

F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

I. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer, as directed.

END OF SECTION 096816

SECTION 096900 - ACCESS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cementitious-core steel panel access flooring.
2. Wood-core steel panel access flooring.
3. Unfilled steel panel access flooring.

1.2 COORDINATION

A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access flooring.

B. Mark pedestal locations on subfloor to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals installed after mechanical and electrical work.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For access flooring:

1. Include layout of access flooring and relationship to adjoining Work based on field-verified dimensions.
2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

D. Samples: For each type of exposed finish.

E. Delegated-Design Submittal: For seismic design of access flooring.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Seismic Design Calculations: For seismic design of access flooring, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design access flooring for seismic performance, including loads imposed on the access flooring by items and equipment installed on the access flooring.

B. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7, including loads imposed on the access flooring by items and equipment installed on the access flooring.

C. Structural Performance: Provide access flooring capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":

1. Concentrated Loads: As directed with the following deflection and permanent set:

   a. Top-Surface Deflection: 0.10 inch (2.54 mm).
   b. Permanent Set: 0.010 inch (0.25 mm).

2. Ultimate Loads:As directed.
3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch (1.02 mm).

   a. CISCA Wheel 1: 10 passes as directed.
   b. CISCA Wheel 2: 10,000 passes as directed.

4. Stringer Load Test: As directed. As directed, at center of span with a permanent set not to exceed 0.010 inch (0.254 mm).
5. Pedestal Axial Load Test: 5000 lbf (22 240 N) or 6000 lbf (26 690 N).
6. Pedestal-Overturning-Moment Test: 1000 lbf x inches (113 N x meters).
7. Uniform Load Test: As directed, with a maximum top-surface deflection not to exceed 0.040 inch (1.02 mm) and a permanent set not to exceed 0.010 inch (0.254 mm).
8. Drop Impact Load Test: As directed.

D. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or 450 or less.

2.2 CEMENTITIOUS-CORE STEEL PANEL ACCESS FLOORING

A. Fabricate panels from cold-rolled steel sheet, with die-cut flat top sheet and die-formed and stiffened bottom pan welded together. Protect metal surfaces against corrosion using manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.

1. Configuration: Provide modular panels with nominal size of 24 by 24 inches (610 by 610 mm), interchangeable with other field panels without disturbing adjacent panels or understructure.
2. Attachment to Understructure: Bolted or by gravity.

B. Perforated Panels: Perforated top surface with holes or slots of number, spacing, and size standard with manufacturer to produce a nominal open area of (As directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: As directed.

C. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of (As directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: Manufacturer's standard or To match solid panels.

D. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.

E. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

F. Floor Finish: Provide factory-applied floor finish fabricated in one piece to cover entire panel face; with integral trim or applied perimeter plastic edging.

1. High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.

a. Electrical Resistance: Average no less than 1 megohm and no more than 20,000 megohms when installed floor coverings are surface-to-ground tested according to NFPA 99.
b. Colors, Textures, and Patterns: As directed.

2. Conductive High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.

a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

3. Static-Dissipative Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).

4.

a. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

5. Conductive Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).

a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

2.3 WOOD-CORE STEEL PANEL ACCESS FLOORING

A. Fabricate panels with 1-inch- (25-mm-) thick particleboard core laminated to top and bottom steel face sheets, and with a flame-spread index of 25 or less according to ASTM E84. Provide core edges enclosed with upturned, die-formed, bottom-sheet edge or with perimeter steel channel welded to top sheet and welded or bonded to bottom sheet. Protect metal surfaces against corrosion by manufacturer's standard factory-applied finish.
1. Configuration: Provide modular panels with nominal size of 24 by 24 inches (610 by 610 mm), interchangeable with other field panels without disturbing adjacent panels or understructure.
2. Attachment to Understructure: Bolted or by gravity.

B. Perforated Panels: Perforated top surface with holes or slots of number, spacing, and size standard with manufacturer to produce a nominal open area of (as directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: Manufacturer's standard or to match solid panels.

C. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of (as directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: Manufacturer's standard or to match solid panels.

D. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.

E. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

F. Floor Finish: Provide factory-applied floor finish fabricated in one piece to cover entire panel face; with integral trim or applied perimeter plastic edging.

1. High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.
   a. Electrical Resistance: Average no less than 1 megohm and no more than 20,000 megohms when installed floor coverings are surface-to-ground tested according to NFPA 99.
   b. Colors, Textures, and Patterns: As directed.

2. Conductive High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.

   a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
   b. Colors, Textures, and Patterns: As directed.

3. Static-Dissipative Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).
   a. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
   b. Colors, Textures, and Patterns: As directed.

4. Conductive Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).

   a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
   b. Colors, Textures, and Patterns: As directed.

2.4 UNFILLED STEEL PANEL ACCESS FLOORING

A. Fabricate panels from cold-rolled steel sheet, with die-cut flat top sheet and die-formed and stiffened bottom pan welded together. Protect metal surfaces against corrosion by manufacturer's standard factory-applied finish.

1. Configuration: Provide modular panels with nominal size of 24 by 24 inches (610 by 610 mm), interchangeable with other field panels without disturbing adjacent panels or understructure.
2. Attachment to Understructure: Bolted or by gravity.

B. Perforated Panels: Perforated top surface with holes or slots of number, spacing, and size standard with manufacturer to produce a nominal open area of (as directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: Manufacturer's standard or to match solid panels.

C. Grates: Grating ribs arranged in manufacturer's standard pattern to produce a nominal open area of (as directed) percent. Provide mechanical dampers with each panel unit.

1. Quantity: As directed.
2. Finish: Manufacturer's standard or to match solid panels.

D. Pedestal System Understructure: System consisting of base, column with provisions for height adjustment, and head (cap); made of steel.

E. Stringer System Understructure: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

F. Floor Finish: Provide factory-applied floor finish fabricated in one piece to cover entire panel face; with integral trim or applied perimeter plastic edging.

1. High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.

    a. Electrical Resistance: Average no less than 1 megohm and no more than 20,000 megohms when installed floor coverings are surface-to-ground tested according to NFPA 99.
    b. Colors, Textures, and Patterns: As directed.

2. Conductive High-Pressure Plastic Laminate: NEMA LD 3, High-Wear type, Grade HDH or Grade HDM.

a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

3. Static-Dissipative Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).

a. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

4. Conductive Vinyl Tile: ASTM F1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface).

a. Electrical Resistance: Average no less than 25,000 ohms and no more than 1 megohm when installed floor coverings are surface-to-ground tested according to ASTM F150 with 100-V applied voltage.
b. Colors, Textures, and Patterns: As directed.

2.5 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch (0.50 mm) of required size.
2. Squareness: Plus or minus 0.015 inch (0.38 mm) between diagonal measurements across top of panel.
3. Flatness: Plus or minus 0.035 inch (0.89 mm), measured on a diagonal on top of panel.

B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Number, Size, Shape, and Location: As directed.
2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.
3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

2.6 ACCESSORIES

A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

B. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide two or four post-installed expansion anchors or threaded concrete screws made from carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal-overturning moment on fasteners, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

C. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:

1. Structural Performance: Cover capable of supporting a concentrated load, as directed.
2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles or Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone connectors and signal cables.
3. Location: In center of panel quadrant unless otherwise indicated.
4. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
5. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:

    a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
    b. Number of Receptacles for Outlet: As directed.
    c. Wiring Method: Factory wired for field hardwiring with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch-(152-mm-) long pigtail.
    d. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.

D. Occupant Adjustable Diffusers: Manufacturer's standard round diffusers, 4 inches (102 mm) or 8 inches (203 mm) in diameter, formed from aluminum or polycarbonate plastic to produce a removable one-piece unit complete with diffuser, manually adjustable flow regulator, dirt and dust receptacle, trim ring, and underfloor compression mounting ring; precisely fitted in factory-prepared openings of standard field panels and complying with the following requirements:

1. Air-Distribution Characteristics: 100 cfm (47 L/s) at 0.096-inch (24-Pa) static pressure and a maximum noise criterion rating of 15.
2. Structural Performance: Capable of supporting a 600-lbf (2669-N) concentrated load.
3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.

E. Floor Grilles: Standard load-bearing grilles formed from aluminum or polycarbonate plastic to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field

panels, with adjustable/removable or without dampers and complying with the following requirements:

1. Air-Distribution Characteristics: 468 cfm at 0.10-inch wg (221 L/s at 25-Pa) static pressure.
2. Structural Performance: Capable of supporting a 1000-lbf (4448-N) concentrated load.
3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.

F. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet as directed at usable area for passage of power and signal cables through plenum walls. Provide ABS plastic or Aluminum frame with passageway of interwoven nylon filaments and intermediate layer of EPDM. Provide units with plastic cable tray for support of cables and protection of wallboard.

G. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.

H. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish, as directed.

I. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.

J. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.

K. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.

1. Provide railings that comply with structural performance requirements specified in Section 055213 "Pipe and Tube Railings" or Section 057300 "Decorative Metal Railings."

L. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required for each computer room.

M. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).

C. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.2 INSTALLATION

A. Install access flooring and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor; and as required to meet seismic design requirements.

C. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors as required to meet seismic design requirements.

D. Adjust pedestals so installed panels are flat, level, and at the proper height.

E. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

F. Install flooring panels securely in place, leaving them properly seated with panel edges flush. Do not force panels into place.

G. Scribe perimeter panels to provide a close fit, with adjoining construction having no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

H. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under installed access flooring.

I. Grounded Access Flooring: Ground access flooring as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.

1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.

J. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.

K. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

L. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.

M. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.

N. Install access flooring without change in elevation between adjacent panels and within the following tolerances:

1. Plus or minus 1/16 inch (1.5 mm) or 1/8 inch (3 mm) in any 10-foot (3-m) distance.
2. Plus or minus 1/8 inch (3 mm) or 1/4 inch (6.5 mm) from a level plane over entire access flooring area.

END OF SECTION 096900

SECTION 096933 - LOW-PROFILE FIXED HEIGHT ACCESS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes low-profile, fixed-height access flooring.

1.2 COORDINATION

A. Coordinate location of electrical work in underfloor cavity and wire management channels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review connections between low-profile, fixed-height access flooring and electrical systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For low-profile, fixed-height access flooring:

D. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Low-profile, fixed-height access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Structural Performance:

1. Loading Capacity: As directed 100-lbf/sq. ft. (4.8-kN/sq. m) or 250-lbf/sq. ft. (12.0-kN/sq. m) live load with the following deflection and permanent set:

    a. Top-Surface Deflection: Maximum 0.15 inch (0.38 mm).
    b. Permanent Set: Maximum 0.06 inch (0.15 mm).

C. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 50 or 450 or less as directed.

2.2 LOW-PROFILE, FIXED-HEIGHT ACCESS FLOORING

A. Low-Profile, Fixed-Height Access Flooring: As directed Manufacturer's standard or reinforced, modular, steel or polymer components, designed to interconnect and provide channels for installation of wiring; with manufacturer's standard factory-applied finish.
1. Module: Low-profile access flooring with nominal module size of 24 by 24 inches (610 by 610 mm) or 23.6 by 23.6 inches (600 by 600 mm) as directed.
2. Height: Low-profile access flooring with nominal height of 1-1/2 inches (38 mm), 2 inches (50 mm) or 3 inches (75 mm) as directed.

B. Service Outlets and Wiring: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:

1. Structural Performance: As directed Cover capable of supporting a 300-lbf (1334-N), 800-lbf (3559-N) or 1000-lbf (4448-N) concentrated load.
2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles or Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone connectors and signal cables as directed.
3. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:

    a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
    b. Number of Receptacles for Outlet: One, Two or Four as directed.
    c. Wiring Method: Factory wired for field hardwiring with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch-(152-mm-) long pigtail.
    d. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch-circuit cables supplied with building electrical system.

C. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.

D. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, of same materials, performance, and construction requirements as low-profile, fixed-height access flooring.

E. Perimeter Support: Manufacturer's standard method for supporting panel edge and forming transition between low-profile, fixed-height access flooring and adjoining floor coverings at same level as low-profile, fixed-height access flooring.

2.3 LOW-PROFILE, FIXED-HEIGHT ACCESS FLOORING WITH MODULAR WIRING

A. Low-Profile, Fixed-Height Access Flooring with Modular Wiring: Manufacturer's standard or reinforced, modular, steel or polymer components, designed to interconnect and provide channels for installation of wiring. Include factory-assembled modular wiring harnesses and service outlets; with manufacturer's standard factory-applied finish.
   1. Height: Provide low-profile access flooring with nominal height of 1-1/2 inches (38 mm), 2 inches (50 mm) or 3 inches (75 mm) as directed.

B. Service Outlets and Wiring: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:

   1. Structural Performance: Cover capable of supporting a 300-lbf (1334-N), 800-lbf (3559-N) or 1000-lbf (4448-N) concentrated load as directed.
   2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles or Grommet with twist-close cover and including steel junction box for electrical receptacle with provision for telephone connectors and signal cables as directed.
   3. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
   4. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with the following requirements:

      a. Type of Receptacle: Heavy-duty duplex, two-pole, three-wire grounding, 20 A, 125 V, NEMA WD 6, Configuration 5-20R unless otherwise indicated.
      b. Number of Receptacles for Outlet: One, Two or Four as directed.
      c. Wiring Method: Factory wired for field hardwiring with armored cable, containing three insulated No. 12 AWG solid-copper conductors, terminated with a 6-inch-(152-mm-) long pigtail.

C. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.

D. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, of same materials, performance, and construction requirements as low-profile, fixed-height access flooring.

E. Perimeter Support: Provide manufacturer's standard method for supporting panel edge and forming transition between low-profile, fixed-height access flooring and adjoining floor coverings at same level as low-profile, fixed-height access flooring.

2.4 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch (0.50 mm) of required size.
2. Flatness: Plus or minus 0.035 inch (0.89 mm), measured on a diagonal on top of panel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Lay out low-profile access flooring installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).

D. Complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.2 INSTALLATION

A. Install low-profile, fixed-height access flooring and accessories under supervision of low-profile, fixed-height access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Install flooring securely in place and properly seated, with panel edges flush. Do not force panels into place.

C. Scribe perimeter panels to provide a close fit with adjoining construction, having no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

END OF SECTION 096933

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl wall covering.
2. Textile wall covering.
3. Wallpaper.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- (914-mm-) long in size.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or 450 or less.

2. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 265 or NFPA 286.

2.2 VINYL WALL COVERING

A. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:

1. FS CCC-W-408D and CFFA-W-101-D, as directed.
2. ASTM F793 for peelable or strippable wall coverings.

a. Category: As directed.

b. Coordinate "Total Weight" Paragraph below with CFFA-W-101-D Type.

B. Total Weight: As directed, excluding coatings.

C. Width: 27 inches (686 mm) or 54 inches (1372 mm).

D. Backing: Fabric, as directed.

1. Fiber Content: As directed.

E. Repeat: Random.

F. Stain-Resistant Coating, as directed.

G. Retain "Colors, Textures, and Patterns" Paragraph below unless manufacturer's product name or designation indicates color, texture, and pattern.

H. Colors, Textures, and Patterns: As directed.

2.3 TEXTILE WALL COVERING

A. Description: Provide wall coverings, as directed, in rolls from same production run and that comply with ASTM F793.

1. Category: As directed.

B. Test Responses:

1. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Grade 3, minimum.
2. Colorfastness to Light: Passes AATCC 16, Test Option 1 or 3, Grade 4, minimum, at 40 hours.

C. Total Weight: As directed, excluding coatings.

D. Width: As directed.

E. Repeat: Random.

F. Applied Backing Material: Acrylic or Paper.

G. Stain-Resistant Coating: As directed.

H. Retain "Colors, "Textures, and Patterns" Paragraph below unless manufacturer's product name or designation indicates color, texture, and pattern.

I. Colors, Textures, and Patterns: As directed.

2.4 WALLPAPER

A. Description: Provide wallpaper, as directed, in rolls from same production run and that complies with ASTM F793.

1. Category: As directed.

B. Total Weight: As directed.

C. Width: 20-1/2 inches (520.7 mm) or 28 inches (711.2 mm).

D. Repeat: Random.

E. Colors, Textures, and Patterns: As directed.

2.5 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Metal Primer: Interior ferrous metal primer complying with Section 099123 "Interior Painting" and recommended in writing by primer and wall-covering manufacturers for intended substrate.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.2 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Match pattern 72 inches (1830 mm) above the finish floor.

F. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) or 6 inches (150 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

I. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

J. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 097513 - STONE WALL FACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes dimension stone paneling on interior walls and columns.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Show fabrication and installation details for stone paneling system, including dimensions and profiles of stone units.

D. Samples:

1. For each stone type indicated. Include two, three, four or five or more Samples in each set and show the full range of variations in appearance characteristics in completed Work.
2. For each color of grout, pointing mortar and sealant required as directed.

E. Delegated-Design Submittal: For stone paneling assembly.

1.3 QUALITY ASSURANCE

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for the following kinds of stone paneling:

    a. Typical stone wall paneling, not less than 72 inches (1800 mm) long by 96 inches (2400 mm) high.
    b. Typical stone wainscot paneling, not less than 72 inches (1800 mm) long by full wainscot height.
    c. Typical column facing, one complete column.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Section of the Specifications.

B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone paneling system.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.

C. Seismic Performance: Stone paneling system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5 or 1.0 as directed.

2.3 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, Thermal, As indicated, Match Architect's sample.

D. Match Architect's samples.

2.4 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Classification: I Low, II Medium or III High Density as directed.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Smooth, Sand rubbed, Machine tooled, four bats per 1 inch (25 mm), Machine tooled, six bats per 1 inch (25 mm), Machine tooled, eight bats per 1 inch (25 mm), As indicated, Match Architect's sample, matching standard ILI finish as directed.

D. Match Architect's samples.

2.5 MARBLE

A. Material Standard: Comply with ASTM C503/C503M, Classification I Calcite, Classification II Dolomite, Group A, Group B, Group C, Group D as directed.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.6 SERPENTINE

A. Material Standard: Comply with ASTM C1526, Classification I Exterior or Classification II Interior as directed.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.7 SLATE

A. Material Standard: Comply with ASTM C629/C629M, Classification I Exterior or Classification II Interior as directed.

B. Varieties and Sources: Subject to compliance with requirements, provide the following,, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Honed, Sand rubbed, Natural cleft, As indicated or Match Architect's sample.

D. Match Architect's samples

2.8 TRAVERTINE

A. Material Standard: Comply with ASTM C1527/C1527M, Classification I Exterior or Classification II Interior.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Cut: Vein or Fleuri as directed.

1. Orientation of Veining: Horizontal, Vertical or As indicated.

D. Filling: Fill pores on faces of stone with cementitious filler of color selected by Architect or matching Architect's sample as directed.

E. Finish: Polished, Honed, As indicated or Match Architect's sample as directed.

F. Match Architect's samples.

2.9 SETTING MATERIALS

A. Molding Plaster: ASTM C59/C59M.

B. Portland Cement: ASTM C150/C150M, Type I or Type II.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

C. Hydrated Lime: ASTM C207, Type S.

D. Aggregate: ASTM C144.

E. Water: Potable.

2.10 GROUT

A. Grout Colors: Match stone, As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.

C. Standard Cement Grout: ANSI A118.6, packaged.

D. High-Performance Tile Grout: ANSI A118.7, packaged.

E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.

2.11 POINTING MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Pigments shall have a record of satisfactory performance in mortar.

D. Aggregate: ASTM C144, except with 100 percent passing No. 16 (1.18-mm) sieve.

1. White Aggregates: Natural white sand or ground white stone.
2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

E. Water: Potable.

2.12 SEALANTS

A. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

2.13 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).

B. Fabricate dowels from stainless steel, ASTM A276, Type 304.

C. Wire Tiebacks: No. 9 AWG copper or copper-alloy or 0.120-inch- (3.0-mm-) diameter, stainless-steel wire.

2.14 STONE ACCESSORIES

A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.

B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.15 STONE FABRICATION

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

B. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
2. Dress joints straight and at right angle to face unless otherwise indicated.

C. Nominal Thickness: 3/4 inch (20 mm), 7/8 inch (22 mm), 1 inch (25 mm), 1-1/4 inches (32 mm) or 2 inches (50 mm) unless otherwise indicated.

D. Cut stone to produce uniform joints 1/16 inch (1.5 mm), 1/8 inch (3 mm), 1/4 inch (6 mm) or 3/8 inch (10 mm) wide and in locations indicated.

E. Quirk-miter corners unless otherwise indicated. Fabricate for anchorage in top and bottom bed joints of corner units.

F. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:

1. Arrange panels with veining horizontal.
2. Arrange panels with veining vertical.
3. Arrange panels with veining as indicated on Drawings.
4. Arrange panels in blend pattern.

2.16 MIXES

A. Spotting Plaster: Stiff mix of molding plaster and water.

B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

C. Setting Mortar: Comply with ASTM C270, Proportion Specification, Type N or Type O as directed.

D. Pointing Mortar: Comply with ASTM C270, Proportion Specification, Type N or Type O as directed. Provide pointing mortar mixed to match Architect's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 SETTING STONE, GENERAL

A. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

B. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.2 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 96 inches (3 mm in 2400 mm), 1/4 inch (6 mm) maximum.

B. Variation from Level: For lintels, sills, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), 3/8 inch (10 mm) maximum.

C. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/32-inch (0.8-mm) difference between planes of adjacent units.

3.3 INSTALLATION OF STONE FACING

A. Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 inches (450 mm) apart across back of unit, but provide no fewer than one setting spot per 2 sq. ft. (0.18 sq. m) unless otherwise indicated.

1. Moisture Exposure: Use portland cement mortar for setting spots where stone is applied to inside face of exterior walls and where indicated.

B. Set units with anchors securely attached to stone and to backup surfaces. Comply with anchoring recommendations in ASTM C1242.

C. Minimum Anchors: Provide anchors at a maximum of 24 inches (600 mm) o.c. around perimeter of stone panels with a minimum of four anchors per panel.

D. Minimum Anchors: Provide a minimum of four anchors per panel up to 12 sq. ft. (1.1 sq. m) in face area, plus a minimum of two additional anchors for each additional 8 sq. ft. (0.7 sq. m).

E. As directed Grout or Point joints after setting stone.

3.4 GROUTING JOINTS

A. Grout stone to comply with ANSI A108.10.

1. Use sanded grout mixture for joints wider than 1/8 inch (3 mm).
2. Use unsanded grout mixture for joints 1/8 inch (3 mm) and narrower.

B. Remove temporary shims before grouting.

C. Tool joints uniformly and smoothly with plastic tool.

3.5 POINTING JOINTS WITH MORTAR

A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than 1/2 inch (13 mm).

B. Point stone joints by placing pointing mortar in layers of not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.

C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint.

3.6 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.7 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean stone paneling as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Clean stone paneling no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

C. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

END OF SECTION 097513

SECTION 097519 - STONE TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior stone trim, including, stone base and stone window stools as directed.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Show fabrication and installation details for stone trim, including dimensions and profiles of stone units.

D. Samples:

1. As directed For each stone type indicated. Include two, three, four or five or more Samples in each set, and show the full range of variations in appearance characteristics in completed Work.
2. For each color of grout or pointing mortar required as directed.

1.3 QUALITY ASSURANCE

A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for typical interior stone trim as shown on Drawings.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.

B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, Thermal, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.3 LIMESTONE

A. Material Standard: Comply with ASTM C568/C568M.

1. Classification: I Low, II Medium or III High Density as directed.

B. Varieties and Sources: As directed Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Smooth, Sand rubbed, Machine tooled, four bats per 1 inch (25 mm), Machine tooled, six bats per 1 inch (25 mm), Machine tooled, eight bats per 1 inch (25 mm), As indicated or Match Architect's sample, matching standard ILI finish.

D. Match Architect's samples.

2.4 MARBLE

A. Material Standard: Comply with ASTM C503/C503M, Classification I Calcite, Classification II Dolomite, Group A, Group B, Group C, Group D as directed.

B. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.5 SERPENTINE

A. Material Standard: Comply with ASTM C1526, Classification I Exterior or Classification II Interior as directed.

B. Varieties and Sources: As directed Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Finish: Polished, Honed, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.6 SLATE

A. Material Standard: Comply with ASTM C629/C629M, Classification I Exterior or Classification II Interior.

B. Varieties and Sources: As directed producers, distributors, or importers.

C. Finish: Honed, Sand rubbed, Natural cleft, As indicated or Match Architect's sample.

D. Match Architect's samples.

2.7 TRAVERTINE

A. Material Standard: Comply with ASTM C1527/C1527M, Classification I Exterior or Classification II Interior as directed.

B. Varieties and Sources: As directed Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

C. Cut: Vein or Fleur as directed.

1. Orientation of Veining: Horizontal, Vertical or As indicated.

D. Filling: Fill pores on faces of stone with cementitious filler of color selected by Architect or matching Architect's sample.

E. Finish: Polished, Honed, As indicated or Match Architect's sample.

F. Match Architect's samples.

2.8 SETTING MATERIALS

A. Molding Plaster: ASTM C59/C59M.

B. Portland Cement: ASTM C150/C150M, Type I or Type II.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

C. Hydrated Lime: ASTM C207, Type S.

D. Aggregate: ASTM C144.

E. Water: Potable.

F. Adhesives, General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.

G. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

2.9 GROUT

A. Grout Colors: Match stone, As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate to produce required color.

C. Standard Cement Grout: ANSI A118.6, packaged.

1. Grout Type: Sanded or Unsanded.

D. High-Performance Cement Grout: ANSI A118.7, packaged.
1. Grout Type: Sanded or Unsanded as directed.

E. Water-Cleanable Epoxy Grout: ANSI A118.3, packaged, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.

2.10 POINTING MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Pigments shall have a record of satisfactory performance in mortar.

D. Aggregate: ASTM C144, except with 100 percent passing No. 16 (1.18-mm) sieve.

1. White Aggregates: Natural white sand or ground white stone.
2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

E. Water: Potable.

2.11 SEALANTS

A. Joint Sealants: Manufacturer's standard sealants that comply with applicable requirements in Section 079200 "Joint Sealants" and will not stain the stone they are applied to.

2.12 STONE ANCHORS AND ATTACHMENTS

A. Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304.

1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F593 (ASTM F738M) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).

B. Fabricate dowels from stainless steel, ASTM A276, Type 304.

C. Wire Tiebacks: No. 9 AWG copper or copper-alloy or 0.120-inch- (3.0-mm-) diameter, stainless-steel wire.

2.13 STONE ACCESSORIES

A. Temporary Setting Shims: Rigid plastic shims, nonstaining to stone, sized to suit joint thickness.

B. Cleaner: Stone cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

C. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.14 STONE FABRICATION

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

B. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association.

1. Where items are installed with adhesive or where stone edges are visible in the finished work, make items uniform in thickness and of identical thickness for each type of item; gage back of stone if necessary.
2. Dress joints straight and at right angle to face unless otherwise indicated.

C. Fabricate molded work to produce stone shapes with a uniform profile throughout entire unit length and with precisely formed arris slightly eased to prevent snipping, matched at joints between units.

1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.

2. Miter moldings at corners, unless otherwise indicated, with edges of miters slightly eased at outside corners.

D. Flat Stone Trim:

1. Nominal Thickness: 3/4 inch (20 mm), 7/8 inch (22 mm), 1-1/4 inches (32 mm) or 1-1/2 inches (40 mm) unless otherwise indicated.
2. Edge Detail: Straight, slightly eased at corners, 3/8-inch (10-mm) bevels, 3/4-inch (20-mm) radii, 3/8-inch (10-mm) radii or as indicated.
3. Joints: 1/16-inch- (1.5-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide, sealant-filled joints or Bonded joints, 1/32 inch (0.8 mm) or less in width as directed.

E. Molded Stone Trim:

1. Profile: Match profiles indicated on Drawings or existing as directed.
2. Joints: 1/16-inch- (1.5-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide, sealant-filled joints or Bonded joints, 1/32 inch (0.8 mm) or less in width as directed.

F. Stone Base:

1. Nominal Thickness: 3/4 inch (20 mm), 7/8 inch (22 mm) or 1-1/4 inches (32 mm) or unless otherwise indicated.
2. Top-Edge Detail: Straight, slightly eased at corner, 3/8-inch (10-mm) bevel, 3/4-inch (20-mm) radius, 3/8-inch (10-mm) radius or as indicated.
3. Ends: Butt ends into casings, Butt ends into opening frames or Return ends to depth of adjacent finish with edge detail same as top edge unless otherwise indicated.
4. Joints: 1/16-inch- (1.5-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide, sealant-filled joints or Bonded joints, 1/32 inch (0.8 mm) or less in width as directed.

G. Stone Window Stools:

1. Nominal Thickness: 3/4 inch (20 mm), 7/8 inch (22 mm) or 1-1/4 inches (32 mm) or unless otherwise indicated.
2. Edge Detail: Straight, slightly eased at corners, 3/8-inch (10-mm) bevel at top edge, bottom corner slightly eased, 3/8-inch (10-mm) radius at top edge, bottom corner slightly eased, 3/4-inch (20-mm) bullnose, 1-1/2-inch (40-mm) laminated bullnose or as indicated.
3. Ends: Extend stools beyond opening as indicated and finish ends to match exposed edge.
4. Joints: 1/16-inch- (1.5-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide grouted joints, 1/8-inch- (3-mm-) wide, sealant-filled joints, Bonded joints, 1/32 inch (0.8 mm) or less in width or Fabricate in one piece without joints as directed.
5. Fabricate window stools in one piece unless otherwise indicated.

2.15 MIXES

A. Spotting Plaster: Stiff mix of molding plaster and water.

B. Mortar, General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

C. Setting Mortar: Comply with ASTM C270, Proportion Specification, Type N or Type O.

D. Pointing Mortar: Comply with ASTM C270, Proportion Specification, Type N or Type O. Provide pointing mortar mixed to match Architect's sample and complying with the following:

1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
2. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.

E. Grout: Comply with mixing requirements of referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 SETTING STONE, GENERAL

A. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.

B. Contiguous Work: Provide reveals and openings as required to accommodate contiguous work.

C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing of expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of plaster, mortar, grout, and other rigid materials.

3.2 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/8 inch in 96 inches (3 mm in 2400 mm), 1/4 inch (6 mm) maximum.

B. Variation from Level: For lintels, sills, window stools, chair rails, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/16 inch (1.5 mm) or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/32-inch (0.8-mm) difference between planes of adjacent units.

3.3 INSTALLATION

A. Stone Trim at Stone Paneling: Set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

B. Stone Trim at Stone Paneling: Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 inches (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone trim up to 48 inches (1200 mm) in length, plus one additional anchor for each additional 24 inches (600 mm) of length.

C. Stone Trim at Gypsum Board: Adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

D. Stone Trim at Gypsum Board: Adhere units to gypsum board with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

E. Stone Base at Stone Paneling: Set units by adhering to stone paneling with water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

F. Stone Base at Stone Paneling: Set units firmly against setting spots. Locate setting spots at anchors and spaced not more than 18 inches (450 mm) apart unless otherwise indicated. Provide no fewer than two anchors per piece for stone base up to 48 inches (1200 mm) in length, plus one additional anchor for each additional 24 inches (600 mm) of length.

G. Stone Base at Gypsum Board: Adhere units to plywood backing with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

H. Stone Base at Gypsum Board: Adhere units to gypsum board with full spread of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

I. Stone Window Stools: Set stone window stools on masonry in a full bed of mortar.

J. Stone Window Stools: Set stone window stools on wood or metal framing or wood blocking in a full bed of water-cleanable epoxy adhesive. Hold adhesive back from exposed edges of joints to allow for grouting.

K. Grout or Point joints after setting stone as directed.

L. Fill indicated joints with sealant after setting and grouting and pointing stone.

3.4 GROUTING JOINTS

A. Grout stone to comply with ANSI A108.10.

1. Use sanded grout mixture for joints wider than 1/8 inch (3 mm).
2. Use unsanded grout mixture for joints 1/8 inch (3 mm) and narrower.

B. Remove temporary shims before grouting.

C. Tool joints uniformly and smoothly with plastic tool.

3.5 POINTING JOINTS WITH MORTAR

A. Prepare stone-joint surfaces for pointing with mortar by removing temporary shims, dust, and mortar particles. Where setting spots occur at joints, rake out excess setting mortar or plaster to a depth of not less than 1/2 inch (13 mm).

B. Point stone joints by placing pointing mortar in layers of not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer. Apply mortar first to areas where depths are greater than surrounding areas until a uniform depth is formed.

C. Tool joints when pointing mortar is thumbprint hard. Use a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint.

3.6 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants to comply with applicable requirements in Section 079200 "Joint Sealants." Remove temporary shims before applying sealants.

3.7 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean interior stone trim as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Clean interior stone trim no fewer than six days after completion of grouting and pointing, using clean water and soft rags or stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.

C. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions and recommendations.

END OF SECTION 097519

SECTION 097713 - STRETCHED-FABRIC WALL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes site-upholstered wall systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each stretched-fabric system.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved:

B. Product certificates.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of stretched-fabric systems that fail in performance, materials, or workmanship within specified warranty period.

1. Warranty Period: Two or Five years from date of Substantial Completion as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Stretched-fabric wall systems shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency on systems prepared according to ASTM E2573. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.2 STRETCHED-FABRIC WALL SYSTEMS

A. Stretched-Fabric Wall System: Manufacturer's standard system consisting of facing material stretched tightly over a frame and core material and secured in the frame.

1. Core: Manufacturer's standard, Glass-fiber board, Glass-fiber blanket, Mineral-fiber board or Cementitious-fiber board as directed.

a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board or impact-resistant, acoustically transparent, copolymer sheet as directed.

2. Frame Edge: Chamfered (beveled), Radiused (bullnosed) or Square profile as directed.

a. Fabric-Insertion Point: Bottom load.
b. Nominal Frame Thickness: Match core thickness, 1/2 inch (13 mm), 3/4 inch (19 mm), 1 inch (25 mm), 1-1/2 inches (38 mm), 2 inches (51 mm) or as indicated on Drawings.

3. Reveals between Panels: Recessed, Flush or Projecting reveals as selected by Architect from manufacturer's full range or as indicated on Drawings.
4. Facing Material: Owner-furnished material or as indicated on Drawings as directed.

5. Acoustical Performance: Sound absorption NRC or SAA of 0.50 to 0.90, 0.60 to 0.70, 0.65 to 0.75, not less than 0.65 or not more than 0.35 as directed according to ASTM C423 for Type A mounting according to ASTM E795.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft. (96 to 112 kg/cu. m), unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Glass-Fiber Blanket: ASTM C553, ASTM C612, or ASTM C665; of type standard with manufacturer; nominal density of 3 to 4 lb/cu. ft. (48 to 64 kg/cu. m); flexible; with tackable, thermally bonded white glass-fiber mat facing; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
3. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively; minimum density of 13 lb/cu. ft. (208 kg/cu. m), and with perforated surface.
4. Cementitious-Fiber Board: Density of not less than 20 lb/cu. ft. (320 kg/cu. m).
5. Tackable, Impact-Resistant, High-Density Board for Face Layer: 1/8-inch- (3.2-mm-) thick layer of compressed molded glass-fiber board with a nominal density of 16 to 18 lb/cu. ft. (256 to 288 kg/cu. m) laminated to face of core.
6. Impact-Resistant, Acoustically Transparent, Copolymer Sheet for Face Layer: 1/16- to 1/8-inch- (1.6- to 3.2-mm-) thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.

B. Frame Construction: Manufacturer's standard, continuous, extruded plastic frame (track).

C. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range or as indicated on Drawings.

1. Applied Treatments: Stain resistance.
2. Lining Material: Manufacturer's standard fabric for each use indicated.

D. Lining Material: Fabric as selected by Architect from manufacturer's full range or as indicated on Drawings.

2.4 INSTALLATION MATERIALS

A. Installation Products: Concealed on back of system, recommended by stretched-fabric system manufacturer to support weight of system, fabric tension, and as follows:
1. Fasteners: Manufacturer's standard.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.

B. Before installation, allow fabric to adjust and become stable in spaces where it will be installed according to stretched-fabric system manufacturer's written instructions. Acclimatize fabric for minimum of 24 hours at ambient temperature and humidity conditions indicated for spaces when occupied for their intended use.

3.2 INSTALLATION

A. Install stretched-fabric systems according to system manufacturer's written instructions.

1. Provide continuous perimeter frames of each profile indicated, designed to be inconspicuous when covered by fabric facing, with smooth edges, and with surface finish that will not telegraph through fabric facing.
2. Install framing around penetrations.
3. Tightly fit framing to adjacent construction and securely attach to substrate.
4. Install core material with full coverage, flush with face of stretched-fabric system frame.
5. Attach frame and core to substrate with adhesive or fasteners or both to support system and prevent deformation of components.
6. Install stretched-fabric systems level and plumb unless otherwise indicated, true in plane, and with fabric square to the grain.

B. Fabric Installation: Apply fabric monolithically in continuous run over area, without joints or reveals, except where panel joints or midspan frames are indicated.

1. Fabric Seams: Sewn seams are not permitted.
2. Fabric Seams: Manufacturer's standard sewn seams, straight and parallel; seam dimensions and locations as indicated on Drawings.
3. Stretch and secure fabric to frame edges and so frame and frame attachment method are concealed by fabric unless otherwise indicated.
4. Stretch fabric tightly and square without puckers, ripples, or distortions. Acclimatize and restretch if recommended by stretched-fabric system manufacturer. Repair distortions, wrinkles, and sagging.

3.3 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 097713

SECTION 097723 - FABRIC-WRAPPED PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, fabric-wrapped wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For panel assembly and installation.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Panels shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 FABRIC-WRAPPED WALL PANELS

A. Fabric-Wrapped Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core or stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Mounting: Edge mounted with splines secured to substrate.
2. Mounting: Back mounted with manufacturer's standard secured to substrate, as directed.
3. Core: As directed.

    a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board or impact-resistant, copolymer sheet.

4. Edge Construction: Manufacturer's standard, as directed.
5. Edge Profile: As directed.
6. Corner Detail in Elevation: As directed.
7. Reveals between Panels: Reveals, as directed
8. Facing Material: As directed.
9. Nominal Core or Overall Panel Thickness: As directed.

2.3 MATERIALS

A. Sustainable Design Requirements: As directed.

B. Core Materials: As directed.

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Glass-Fiber Blanket: ASTM C612, ASTM C553, or ASTM C665; of type standard with manufacturer; with tackable, thermally bonded, white glass-fiber mat facing; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
3. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively.
4. Medium-Density Fiberboard: Panels complying with ANSI A208.2.

a. Fire-retardant panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E84 or UL 723.

5. Particleboard: Panels complying with ANSI A208.1, grade to suit performance requirements.

   a. Fire-retardant panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E84 or UL 723.

6. Tackable, Impact-Resistant, High-Density Board for Face Layer: 1/8-inch- (3.2-mm-) thick layer of compressed, molded glass-fiber board with a nominal density of 16 to 18 lb/cu. ft. (256 to 288 kg/cu. m) laminated to face of core.
7. Impact-Resistant, Copolymer Sheet for Face Layer: 1/16- to 1/8-inch- (1.6- to 3.2-mm-) thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.
8. Wood and Plywood: Manufacturer's standard plywood or clear, vertical grain, straight, kiln-dried hardwood.

   a. Fire-retardant treated by pressure process with a flame-spread index of 25 or less when tested according to ASTM E84 or UL 723, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

      1) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity.
      2) Kiln-dry material after treatment to 19 percent for lumber and 15 percent or less for plywood.

C. Facing Material: Fabric from same dye lot; color and pattern as directed.

1. Applied Treatments: Stain resistance.
2. Lining Material: As directed.

D. Mounting Devices: Concealed on back of panel, recommended by manufacturer to support weight of panel, and as follows:

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

C. Facing Material and Lining Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.

D. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch (1.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panels in locations indicated. Unless otherwise indicated, install panels with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

C. Align fabric pattern and grain with adjacent panels.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 097723

SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, sound-absorbing acoustical panel units tested for acoustical performance.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For unit assembly and installation.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core or stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Mounting: Edge mounted with splines secured to substrate.
2. Mounting: Back mounted with manufacturer's standard secured to substrate, as directed.
3. Core: As directed. Provide wood or plywood nailing strips in core where indicated.

    a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board or impact-resistant, acoustically transparent, copolymer sheet .

4. Edge Construction: Manufacturer's standard, as directed.
5. Edge Profile: As directed.
6. Corner Detail in Elevation: Square or Round, radius as directed with continuous edge profile indicated.
7. Reveals between Panels: Reveals, as directed.
8. Facing Material: As directed.
9. Acoustical Performance: Sound absorption NRC or SAA as directed, according to ASTM C423 for Type A mounting according to ASTM E795.
10. Nominal Core or Overall Panel Thickness: As directed.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively, and with perforated surface.
3. Tackable, Impact-Resistant, High-Density Board for Face Layer: 1/8-inch- (3.2-mm-) thick layer of compressed molded glass-fiber board with a nominal density of 16 to 18 lb/cu. ft. (256 to 288 kg/cu. m) laminated to face of core.
4. Impact-Resistant, Acoustically Transparent, Copolymer Sheet for Face Layer: 1/16- to 1/8-inch- (1.6- to 3.2-mm-) thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.

5. Wood and Plywood: Manufacturer's standard plywood or clear, vertical grain, straight, kiln-dried hardwood.

    a. Fire-retardant treated by pressure process with a flame-spread index of 25 or less when tested according to ASTM E84 or UL 723, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

        1) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity.
        2) Kiln-dry material after treatment to 19 percent or less for lumber and 15 percent or less for plywood.

B. Facing Material: Fabric from same dye lot; color and pattern as directed.

1. Applied Treatments: Stain resistance.

C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, sound-absorbing acoustical panel units tested for acoustical performance.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For unit assembly and installation.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.2 SOUND-ABSORBING CEILING UNITS

A. Sound-Absorbing Ceiling Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core or stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Mounting: Back mounted with manufacturer's standard secured to substrate, as directed.
2. Core: As directed.
3. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
4. Edge Profile: As directed.
5. Corner Detail in Elevation: As directed with continuous edge profile indicated.
6. Reveals between Panels: Reveals, as directed.
7. Facing Material: As directed.
8. Acoustical Performance: Sound absorption NRC or SAA as directed according to ASTM C423 for Type A or Type J mounting according to ASTM E795.
9. Nominal Core or Overall Panel Thickness: As directed.

2.3 MATERIALS

A. Sustainable Design Requirements: As directed.

B. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer, unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively, and with perforated surface.

C. Facing Material: Fabric from same dye lot; color and pattern as directed.

1. Applied Treatments: Stain resistance.

D. Mounting Devices: Concealed on back or top edge of unit, recommended by manufacturer to support weight of unit.

2.4 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Measure each area and establish layout of panels and joints of sizes indicated on Drawings within a given area.

C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent units.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098436

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on exterior substrates or the following exterior substrates:

1. Concrete.
2. Fiber-cement board.
3. Clay masonry.
4. Concrete masonry units (CMUs).
5. Steel and iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Copper.
9. Stainless steel.
10. Wood.
11. Plastic.
12. Portland cement plaster (stucco).
13. Gypsum board.
14. Cotton or canvas insulation covering.
15. ASJ insulation covering.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals: As required.

C. Samples: For each type of paint system and each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, as directed, listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

Colors: As directed.

3. Percent of surface area will be painted with deep tones, as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI EXT 3.1A or MPI EXT 3.1K:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Prime Coat: Latex, exterior, matching topcoat.
c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

e. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

f. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

g. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex over Latex Aggregate System MPI EXT 3.1B:

a. Prime Coat: Textured coating, latex, flat, MPI #42.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Latex Aggregate System MPI EXT 3.1N:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

4. High-Build Latex System MPI EXT 3.1L: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build, MPI #40.

1) As directed.

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Paint System MPI EXT 3.2A:

a. Prime Coat: Floor paint, latex, matching topcoat.
b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3), MPI #60.

1) As directed.

2. Alkyd Floor Enamel System MPI EXT 3.2D:

a. Prime Coat: Floor enamel, matching topcoat.
b. Intermediate Coat: Floor enamel, matching topcoat.
c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

1) As directed.

d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

3. Clear Water-Based Sealer System MPI EXT 3.2H:

a. Prime Coat: Sealer, water based, matching topcoat.
b. Intermediate Coat: Sealer, water based, matching topcoat.
c. Topcoat: Sealer, water based, for concrete floors, MPI #99.

1) As directed.

4. Clear Sealer System MPI EXT 3.2G:

a. Prime Coat: Sealer, solvent based, matching topcoat.
b. Intermediate Coat: Sealer, solvent based, matching topcoat.
c. Topcoat: Sealer, solvent based, for concrete floors, MPI #104.

1) As directed.

C. Cement Board Substrates:

1. Latex System MPI EXT 3.3A or MPI EXT 3.3J:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

e. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

f. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

g. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex Aggregate System MPI EXT 3.3G:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

3. High-Build Latex System MPI EXT 3.3H: Dry film thickness of not less than 10 mils (0.25 mm).

    a. Prime Coat: As recommended in writing by topcoat manufacturer.
    b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
    c. Topcoat: Latex, exterior, high build, MPI #40.

        1) As directed.

4. Alkyd System MPI EXT 3.3B:

    a. Prime Coat: Primer, latex for exterior wood, MPI #6.

        1) As directed.

    b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
    c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

        1) As directed.

    d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

        1) As directed.

    e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

        1) As directed.

D. Clay Masonry Substrates:

1. Latex System MPI EXT 4.1A:

    a. Prime Coat: Latex, exterior, matching topcoat.
    b. Intermediate Coat: Latex, exterior, matching topcoat.
    c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

        1) As directed.

    d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

        1) As directed.

    e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

        1) As directed.

    f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

        1) As directed.

2. Latex Aggregate System MPI EXT 4.1B:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

3. High-Build Latex System MPI EXT 4.1H: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build, MPI #40.

1) As directed.

E. CMU Substrates:

1. Latex System MPI EXT 4.2A:

a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex over Alkali-Resistant Primer System MPI EXT 4.2L:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Latex Aggregate System MPI EXT 4.2B:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

4. High-Build Latex System MPI EXT 4.2K: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build, MPI #40.

1) As directed.

F. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.1C or MPI EXT 5.1M:

a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.

1) As directed.

b. Prime Coat: Primer, rust inhibitive, water based MPI #107.

1) As directed.

c. Prime Coat: Primer, epoxy, anti-corrosive MPI #101.

1) As directed.

d. Prime Coat: Shop primer specified in Section where substrate is specified.
e. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
f. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

1) As directed.

g. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) As directed.

h. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

1) As directed.

2. Alkyd System MPI EXT 5.1D or MPI EXT 5.1Q:

a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.

1) As directed.

b. Prime Coat: Shop primer specified in Section where substrate is specified.
c. Prime Coat: Primer, metal, surface tolerant, MPI #23.

1) As directed.

d. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
e. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

f. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

g. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

3. Quick-Dry Enamel System MPI EXT 5.1A:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5), MPI #81.

1) As directed.

d. Topcoat: Alkyd, quick dry, gloss (MPI Gloss Level 7), MPI #96.

1) As directed.

4. Aluminum Paint System MPI EXT 5.1K:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

b. Prime Coat: Shop primer specified in Section where substrate is specified.
c. Intermediate Coat: Aluminum paint, matching topcoat.
d. Topcoat: Aluminum paint, MPI #1.

1) As directed.

G. Galvanized-Metal Substrates:

1. Latex System MPI EXT 5.3H:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Water-Based Light Industrial Coating System MPI EXT 5.3J:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

1) As directed.

d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) As directed.

e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

1) As directed.

3. Alkyd System MPI EXT 5.3B:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

H. Aluminum Substrates:

1. Latex System MPI EXT 5.4H:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Water-Based Light Industrial Coating System MPI EXT 5.4G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

1) As directed.

d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) As directed.

e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6, MPI #164.

1) As directed.

3. Alkyd System MPI EXT 5.4F:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.

c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

I. Copper Substrates:

1. Latex System MPI EXT 5.5H:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6, MPI #119.

1) As directed.

2. Water-Based Light Industrial Coating System MPI EXT 5.5G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

1) As directed.

d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) As directed.

e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

1) As directed.

3. Alkyd System MPI EXT 5.5F:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

J. Stainless-Steel Substrates:

1. Latex System MPI EXT 5.6F:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Water-Based Light Industrial Coating System MPI EXT 5.6G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

1) As directed.

d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) As directed.

e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164.

1) As directed.

K. Wood Substrates: Glued-laminated construction.

1. Latex over Latex Primer System MPI EXT 6.1L:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex over Alkyd Primer System MPI EXT 6.1A:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Alkyd System MPI EXT 6.1B:

   a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

      1) As directed.

   b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
   c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

      1) As directed.

   d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

      1) As directed.

   e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

      1) As directed.

L. Wood Substrates: Exposed framing.

1. Latex over Latex Primer System MPI EXT 6.2M:

   a. Prime Coat: Primer, latex for exterior wood, MPI #6.

      1) As directed.

   b. Intermediate Coat: Latex, exterior, matching topcoat.
   c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

      1) As directed.

   d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

      1) As directed.

   e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

      1) As directed.

   f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

      1) As directed.

2. Latex over Alkyd Primer System MPI EXT 6.2A:

   a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

      1) As directed.

   b. Intermediate Coat: Latex, exterior, matching topcoat.
   c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Alkyd System MPI EXT 6.2C:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

M. Wood Substrates: As directed.

1. Latex over Latex Primer System MPI EXT 6.3L:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex System MPI EXT 6.3A:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Alkyd System MPI EXT 6.3B:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

N. Wood Substrates: Wood-based panel products.

1. Latex over Latex Primer System MPI EXT 6.4K:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex over Alkyd Primer System MPI EXT 6.4G:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

3. Alkyd System MPI EXT 6.4B:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

O. Wood Substrates: Traffic surfaces, including lumber decking and stairs.

1. Latex Porch and Floor Paint over Latex Primer System MPI EXT 6.5E:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.

1) As directed.

b. Intermediate Coat: Latex floor paint, matching topcoat.
c. Topcoat: Latex floor paint, low gloss, MPI #60.

1) As directed.

d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

2. Latex Porch and Floor Paint over Alkyd Primer System MPI EXT 6.5A:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.
b. Intermediate Coat: Latex floor paint, matching topcoat.
c. Topcoat: Latex floor paint, low gloss, MPI #60.

1) As directed.

d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

3. Alkyd Floor Enamel System MPI EXT 6.5B:

a. Prime Coat: Floor enamel, alkyd, gloss, matching topcoat.
b. Intermediate Coat: Floor enamel, alkyd, gloss, matching topcoat.
c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

1) As directed.

d. Additive: Manufacturer's standard additive to increase skid resistance of painted surface.

P. Plastic Trim Fabrication Substrates:

1. Latex System MPI EXT 6.8A:

a. Prime Coat: Primer, bonding, water based, MPI #17.

1) As directed.

b. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

e. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

f. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

g. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Alkyd System MPI EXT 6.8B:

a. Prime Coat: Primer, bonding, water based, MPI #17.

1) As directed.

b. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

c. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
d. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

e. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

f. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

Q. Portland Cement Plaster Substrates:

1. Latex System MPI EXT 9.1A or MPI EXT 9.1J:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

e. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

f. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

g. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. High-Build Latex System MPI EXT 9.1H: Dry film thickness of not less than 10 mils (0.25 mm).

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Latex, exterior, high build, MPI #40.

1) As directed.

R. Exterior Gypsum Board Substrates:

1. Latex System MPI EXT 9.2A:

a. Prime Coat: Primer, latex for exterior wood (reduced), MPI #6.

1) As directed.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Latex Aggregate System MPI EXT 9.2C:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

3. Alkyd System MPI EXT 9.2B:

a. Prime Coat: Primer, latex for exterior wood (reduced), MPI #6.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

S. Exterior Canvas Substrates:

1. Latex System MPI EXT 10.1A:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.

1) As directed.

e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

1) As directed.

f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119.

1) As directed.

2. Alkyd System MPI EXT 10.1C:

a. Prime Coat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.

1) As directed.

d. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5, MPI #94.

1) As directed.

e. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6), MPI #9.

1) As directed.

3. Aluminum Paint System MPI EXT 10.1D:

a. Prime Coat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

1) As directed.

b. Intermediate Coat: Aluminum paint, matching topcoat.
c. Topcoat: Aluminum paint, MPI #1.

1) As directed.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Cement board.
3. Clay masonry.
4. Concrete masonry units (CMUs).
5. Steel and iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Plastic.
10. Gypsum board.
11. Plaster.
12. Spray-textured ceilings.
13. Cotton or canvas insulation covering.
14. ASJ insulation covering.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements listed in the Interior Painting Schedule for the paint category indicated, as directed.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As directed.

1. Percent of surface area will be painted with deep tones, as directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI INT 3.1A or MPI INT 3.1E:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Prime Coat: Latex, interior, matching topcoat.
c. Intermediate Coat: Latex, interior, matching topcoat.
d. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

g. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

h. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

i. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Latex Aggregate System MPI INT 3.1B:

a. Prime Coat: Textured coating, latex, flat, MPI #42.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Latex Aggregate System MPI INT 3.1N:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

4. Institutional Low-Odor/VOC Latex System MPI INT 3.1M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

5. High-Performance Architectural Latex System MPI INT 3.1C:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

6. Water-Based Light Industrial Coating System MPI INT 3.1L:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

7. Alkyd System MPI INT 3.1D:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Enamel System MPI INT 3.2A:

a. Prime Coat: Floor paint, latex, matching topcoat.
b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3), MPI #60.

1) As directed.

2. Alkyd Floor Enamel System MPI INT 3.2B:

a. Prime Coat: Floor enamel, alkyd, matching topcoat.
b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.

c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

1) As directed.

3. Concrete Stain System MPI INT 3.2E:

a. First Coat: Stain, interior, for concrete floors, matching topcoat.
b. Topcoat: Stain, interior, for concrete floors, MPI #58.

1) As directed.

4. Water-Based Concrete Floor Sealer System MPI INT 3.2G:

a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, water based, for concrete floors, MPI #99.

5. Solvent-Based Concrete Floor Sealer System MPI INT 3.2F:

a. First Coat: Sealer, solvent based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, solvent based, for concrete floors, MPI #104.

1) As directed.

C. Cement Board Substrates:

1. Latex System MPI INT 3.3A:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Institutional Low-Odor/VOC Latex System MPI INT 3.3G:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

3. High-Performance Architectural Latex System MPI INT 3.3B:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

4. Water-Based Light Industrial Coating System MPI INT 3.3H:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

5. Alkyd System MPI INT 3.3C:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

D. Clay Masonry Substrates:

1. Latex System MPI INT 4.1A:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex Aggregate System MPI INT 4.1B:

a. Prime Coat: Primer for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
b. Intermediate Coat: Intermediate coat for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 4.1M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 4.1L:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Water-Based Light Industrial Coating System MPI INT 4.1C:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

6. Alkyd System MPI INT 4.1D:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

E. CMU Substrates:

1. Latex System MPI INT 4.2A:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex Aggregate System MPI INT 4.2B:

a. Prime Coat: Primer for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.

b. Intermediate Coat: Intermediate coat for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) As directed.

d. Topcoat: Textured coating, latex, flat, MPI #42.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 4.2D or MPI INT 4.2P:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) As directed.

c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

g. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Water-Based Light Industrial Coating System MPI INT 4.2K:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

6. Alkyd System MPI INT 4.2C or MPI INT 4.2N:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) As directed.

b. Sealer Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

c. Intermediate Coat: Alkyd, interior, matching topcoat.
d. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

f. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

g. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

F. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q or MPI INT 5.1QQ:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Latex, interior, matching topcoat.
e. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

g. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

h. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

i. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

j. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Shop-Applied Quick-Drying Shop Primer System MPI INT 5.1X:

a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 5.1R or MPI INT 5.1R:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

g. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

h. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Water-Based Light Industrial Coating System MPI INT 5.1B:

a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

6. Water-Based Dry-Fall System MPI INT 5.1C or MPI INT 5.1CC:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.

d. Topcoat: Dry fall, latex, flat, MPI #118.

1) As directed.

e. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.

1) As directed.

f. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.

1) As directed.

g. Topcoat: Dry fall, latex (MPI Gloss Level 5), MPI #226.

1) As directed.

7. Alkyd System MPI INT 5.1E or MPI INT 5.1EE:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Alkyd, interior, matching topcoat.
e. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

f. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

g. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

h. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

8. Alkyd over Surface-Tolerant Primer System MPI INT 5.1T:

a. Prime Coat: Primer, metal, surface tolerant MPI #23.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

9. Quick-Dry Enamel System MPI INT 5.1A:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5), MPI #81.

1) As directed.

d. Topcoat: Alkyd, quick dry, gloss (MPI Gloss Level 7), MPI #96.

1) As directed.

10. Alkyd Dry-Fall System MPI INT 5.1D or MPI INT 5.1DD:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Topcoat: Dry fall, alkyd, flat, MPI #55.

1) As directed.

e. Topcoat: Dry fall, alkyd (MPI Gloss Level 3), MPI #89.

1) As directed.

f. Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5), MPI #225.

1) As directed.

11. Aluminum Paint System MPI INT 5.1M or MPI INT 5.1MM:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) As directed.

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) As directed.

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Aluminum paint, matching topcoat.

e. Topcoat: Aluminum paint, MPI #1.

1) As directed.

G. Galvanized-Metal Substrates:

1. Latex System MPI INT 5.3A:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

3. High-Performance Architectural Latex System MPI INT 5.3M:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

4. Water-Based Light Industrial Coating System MPI INT 5.3B:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

5. Water-Based Dry-Fall System MPI INT 5.3H:

a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.

1) As directed.

6. Alkyd over Cementitious Primer System MPI INT 5.3C:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

7. Alkyd Dry-Fall System (Cementitious Primer) MPI INT 5.3F:

   a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

      1) As directed.

   b. Topcoat: Dry fall, alkyd, flat, MPI #55.

      1) As directed.

   c. Topcoat: Dry fall, alkyd (MPI Gloss Level 3), MPI #89.

      1) As directed.

   d. Topcoat: Dry fall, alkyd, semi-gloss (MPI Gloss Level 5), MPI #225.

      1) As directed.

8. Aluminum Paint System (Cementitious Primer) MPI INT 5.3G:

   a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

      1) As directed.

   b. Intermediate Coat: Aluminum paint, matching topcoat.
   c. Topcoat: Aluminum paint, MPI #1.

      1) As directed.

H. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System MPI INT 5.4H:

   a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

      1) As directed.

   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

      1) As directed.

   d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

      1) As directed.

   e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

      1) As directed.

   f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Institutional Low-Odor/VOC Latex System MPI INT 5.4G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

3. High-Performance Architectural Latex System MPI INT 5.4F:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95:

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

4. Water-Based Light Industrial Coating System MPI INT 5.4E:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) As directed.

d. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), MPI #153.

1) As directed.

e. Topcoat: Light industrial coating, interior, water based, gloss (MPI Gloss Level 6), MPI #154.

1) As directed.

5. Alkyd System MPI INT 5.4A or MPI INT 5.4:

a. Prime Coat: Primer, vinyl wash, MPI #80.

1) As directed.

b. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) As directed.

c. Intermediate Coat: Alkyd, interior, matching topcoat.
d. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

f. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

g. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

I. Wood Substrates: Glued-laminated construction.

1. Latex over Latex Primer System MPI INT 6.1M:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Alkyd Primer System MPI INT 6.1A:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 6.1Q:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 6.1N:

a. Prime Coat: Primer, latex, for interior wood, MPI #39:

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Alkyd System MPI INT 6.1B:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

J. Wood Substrates: Exposed framing.

1. Latex over Latex Primer System MPI INT 6.2D:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Alkyd Primer System MPI INT 6.2A:

   a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

      1) As directed.

   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

      1) As directed.

   d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

      1) As directed.

   e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

      1) As directed.

   f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

      1) As directed.

   g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

      1) As directed.

   h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

      1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 6.2L:

   a. Prime Coat: Primer, latex, for interior wood, MPI #39.

      1) As directed.

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
   c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

      1) As directed.

   d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

      1) As directed.

   e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 6.2B:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Alkyd System MPI INT 6.2C:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

K. Wood Substrates: As directed.

1. Latex over Latex Primer System MPI INT 6.3T:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Alkyd Primer System MPI INT 6.3U:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 6.3A:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Water-Based Alkyd System MPI INT 6.3BB:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Alkyd, water based, matching topcoat.

c. Topcoat: Alkyd, water based, gloss (MPI Gloss Level 6-7), MPI #157.

1) As directed.

6. Alkyd System MPI INT 6.3B:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

L. Wood Substrates: Wood paneling and casework.

1. Latex over Latex Primer System MPI INT 6.4R:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Alkyd Sealer System MPI INT 6.4A:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 6.4T:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 6.4S:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Alkyd over Alkyd Sealer System MPI INT 6.4B:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

M. Wood Substrates: Traffic surfaces, including floors and stairs.

1. Latex Porch & Floor Enamel System MPI INT 6.5G:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3), MPI #60.

1) As directed.

2. Alkyd Floor Enamel System MPI INT 6.5A:

a. Prime Coat: Floor enamel, alkyd, matching topcoat.
b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.
c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

1) As directed.

N. Plastic Substrates:

1. Latex System MPI INT 6.8E:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Institutional Low-Odor/VOC Latex System MPI INT 6.8F:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

3. High-Performance Architectural Latex System MPI INT 6.8A:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

4. Alkyd System MPI INT 6.8B:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

O. Spray-Textured Ceiling Substrates:

1. Latex, Flat System MPI INT 9.1A Spray applied.

a. Prime Coat: Latex, interior, flat, matching topcoat.
b. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

2. Latex System MPI INT 9.1E: Spray applied.

a. Prime Coat: Latex, interior, matching topcoat.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Alkyd, Flat System MPI INT 9.1C:

a. Prime Coat: Alkyd, interior, flat matching topcoat.
b. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

4. Alkyd over Alkyd Sealer System MPI INT 9.1D:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

P. Gypsum Board and Plaster Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

b. Prime Coat: Latex, interior, matching topcoat.
c. Intermediate Coat: Latex, interior, matching topcoat.
d. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

g. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

h. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

i. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

2. Latex over Alkyd Primer System (for Plaster Only) MPI INT 9.2K:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) As directed.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

1) As directed.

d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

1) As directed.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) As directed.

f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

1) As directed.

g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed.

3. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

4. High-Performance Architectural Latex System MPI INT 9.2B:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), MPI #138.

1) As directed.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) As directed.

e. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

1) As directed.

f. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.

1) As directed.

5. Alkyd over Latex Sealer System MPI INT 9.2C:

   a. Prime Coat: Primer sealer, latex, interior, MPI #50.

      1) As directed.

   b. Intermediate Coat: Alkyd, interior, matching topcoat.
   c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

      1) As directed.

   d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

      1) As directed.

   e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

      1) As directed.

   f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

      1) As directed.

Q. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings, as directed.

1. Latex System MPI INT 10.1A:

   a. Prime Coat: Primer sealer, latex, interior, MPI #50.

      1) As directed.

   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.

      1) As directed.

   d. Topcoat: Latex, interior (MPI Gloss Level 2), MPI #44.

      1) As directed.

   e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

      1) As directed.

   f. Topcoat: Latex, interior (MPI Gloss Level 4), MPI #43.

      1) As directed.

   g. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

      1) As directed.

h. Topcoat: Latex, interior, gloss (MPI Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

1) As directed..

2. Institutional Low-Odor/VOC Latex System MPI INT 10.1D:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

1) As directed.

d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144.

1) As directed.

e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) As directed.

f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146.

1) As directed.

g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

1) As directed.

h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

1) As directed.

3. Alkyd System MPI INT 10.1B:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (MPI Gloss Level 1), MPI #49.

1) As directed.

d. Topcoat: Alkyd, interior, (MPI Gloss Level 3), MPI #51.

1) As directed.

e. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) As directed.

f. Topcoat: Alkyd, interior, gloss (MPI Gloss Level 6), MPI #48.

1) As directed.

4. Aluminum Paint System MPI INT 10.1C:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) As directed.

b. Intermediate Coat: Aluminum paint matching topcoat.
c. Topcoat: Aluminum paint, MPI #1.

1) As directed.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of wood stains and transparent finishes on the following substrates:

1. Exterior Substrates:

a. Exposed glued-laminated beams and columns.
b. Exposed framing.
c. Dressed lumber (finish carpentry or woodwork).
d. Wood-based panel products.
e. Wood decks and stairs.
f. Wood shingles and shakes (excluding roofs).

2. Interior Substrates:

a. Exposed glued-laminated beams and columns.
b. Exposed framing.
c. Dressed lumber (finish carpentry or woodwork).
d. Wood-based panel products.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of finish system and in each color and gloss of finish required.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in wood finish systems schedules or comparable products by one of the following:

1. As directed.

B. Products: Subject to compliance with requirements, listed in wood finish systems schedules for the product category indicated, as directed.

2.2 MATERIALS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Stain Colors: As directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: percentage, when measured with an electronic moisture meter, as directed.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Solid-Color, Solvent-Based Stain System MPI EXT 6.1C:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

2. Varnish over Semitransparent Stain System MPI EXT 6.1D:

a. Stain Coat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

3. Water-Based Varnish System MPI EXT 6.1M:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish (MPI Gloss Level 1), MPI #191.

1) As directed.

d. Topcoat: Water-based varnish (MPI Gloss Level 2), MPI #192.

1) As directed.

e. Topcoat: Water-based varnish (MPI Gloss Level 3), MPI #193.

1) As directed.

f. Topcoat: Water-based varnish (MPI Gloss Level 4), MPI #194.

1) As directed.

g. Topcoat: Water-based varnish (MPI Gloss Level 5), MPI #195.

1) As directed.

h. Topcoat: Water-based varnish (MPI Gloss Level 6), MPI #196.

1) As directed.

i. Topcoat: Water-based varnish (MPI Gloss Level 7), MPI #197.

1) As directed.

4. Varnish System MPI EXT 6.1K:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

5. Clear, Two-Component Polyurethane Varnish over Stain System MPI EXT 6.1E:

a. Stain Coat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

b. First Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
c. Second Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
d. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7), MPI #78.

1) As directed.

6. Clear, Two-Component Polyurethane Varnish System MPI EXT 6.1H:

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
b. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7), MPI #78.

1) As directed.

B. Wood Substrates: Exposed framing.

1. Solid-Color, Water-Based Stain System MPI EXT 6.2B:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

1) As directed.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.2D:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

3. Water-Based Semitransparent Stain System MPI EXT 6.2P:

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent, MPI #156.

1) As directed.

4. Semitransparent Stain System MPI EXT 6.2L:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.

b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

5. Varnish over Stain System MPI EXT 6.2E:

a. Stain Coat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

6. Water-Based Varnish System MPI EXT 6.2N:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish (MPI Gloss Level 1), MPI #191.

1) As directed.

d. Topcoat: Water-based varnish (MPI Gloss Level 2), MPI #192.

1) As directed.

e. Topcoat: Water-based varnish (MPI Gloss Level 3), MPI #193.

1) As directed.

f. Topcoat: Water-based varnish (MPI Gloss Level 4), MPI #194.

1) As directed.

g. Topcoat: Water-based varnish (MPI Gloss Level 5), MPI #195.

1) As directed.

h. Topcoat: Water-based varnish (MPI Gloss Level 6), MPI #196.

1) As directed.

i. Topcoat: Water-based varnish (MPI Gloss Level 7), MPI #197.

1) As directed.

7. Varnish System MPI EXT 6.2K:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

8. Clear, Two-Component Polyurethane Varnish System MPI EXT 6.2Q:

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
b. Intermediate Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7), MPI #78.

1) As directed.

C. Wood Substrates: As directed.

1. Solid-Color, Water-Based Stain System MPI EXT 6.3K:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

1) As directed.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.3C:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

3. Water-Based Semitransparent Stain System MPI EXT 6.3N:

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent, MPI #156.

1) As directed.

4. Semitransparent Stain System MPI EXT 6.3D:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

5. Varnish over Stain System MPI EXT 6.3E:

a. Stain Coat: Stain, exterior, solvent-based, semitransparent, MPI #13.

1) As directed.

b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

6. Water-Based Varnish System MPI EXT 6.3M:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Water-based varnish (MPI Gloss Level 1), MPI #191.

1) As directed.

d. Topcoat: Water-based varnish (MPI Gloss Level 2), MPI #192.

1) As directed.

e. Topcoat: Water-based varnish (MPI Gloss Level 3), MPI #193.

1) As directed.

f. Topcoat: Water-based varnish (MPI Gloss Level 4), MPI #194.

1) As directed.

g. Topcoat: Water-based varnish (MPI Gloss Level 5), MPI #195.

1) As directed.

h. Topcoat: Water-based varnish (MPI Gloss Level 6), MPI #196.

1) As directed.

i. Topcoat: Water-based varnish (MPI Gloss Level 7), MPI #197.

1) As directed.

7. Varnish System MPI EXT 6.3F:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

8. Clear, Two-Component Polyurethane Varnish System MPI EXT 6.3G:

a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
b. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7), MPI #78.

1) As directed.

D. Wood Substrates: Wood-based panel products.

1. Solid-Color, Water-Based Stain System MPI EXT 6.4A:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.

1) As directed.

b. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

c. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
d. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

1) As directed.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.4C:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

3. Water-Based Semitransparent Stain System MPI EXT 6.4L:

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent, MPI #156.

1) As directed.

4. Semitransparent Stain System MPI EXT 6.4D:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

5. Varnish over Stain System MPI EXT 6.4J:

a. Stain Coat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

b. First Intermediate Coat: Varnish matching topcoat.

c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

6. Varnish System MPI EXT 6.4H:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5), MPI #30.

1) As directed.

e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6), MPI #29.

1) As directed.

f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7), MPI #28.

1) As directed.

E. Wood Substrates: Traffic surfaces including lumber decking and stairs.

1. Deck Stain over Wood Preservative System MPI EXT 6.5D:

a. Preservative Coat: Preservative, for exterior wood, MPI #37.

1) As directed.

b. Intermediate Coat: Stain, for exterior wood decks, matching topcoat.
c. Top coat: Stain, for exterior wood decks, MPI #33.

1) As directed.

2. Deck Stain System MPI EXT 6.5F:

a. Prime Coat: Stain, for exterior wood decks, matching topcoat.

b. Top coat: Stain, for exterior wood decks, MPI #33.

1) As directed.

F. Wood Substrates: Wood shingles and shakes (excluding roofs).

1. Solid-Color, Water-Based Stain System MPI EXT 6.6D:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

1) As directed.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.6C:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

3. Semitransparent Stain System MPI EXT 6.6F:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

3.6 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Solid-Color Latex Stain System MPI INT 6.1T:

a. Prime Coat: Primer, alkyd for exterior wood, MPI #5.

1) As directed.

b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide, MPI #16.

1) As directed.

2. Solid-Color, Solvent-Based Stain System MPI INT 6.1H:

a. Prime Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, solid hide, MPI #14.

1) As directed.

3. Semitransparent Stain System MPI INT 6.1G:

a. Prime Coat: Stain, semitransparent, matching topcoat.
b. Topcoat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

4. Water-Based Varnish over Stain System MPI INT 6.1R:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

1) As directed.

e. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

f. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

5. Water-Based Varnish System MPI INT 6.1F:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

1) As directed.

d. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

e. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

6. Alkyd Varnish over Stain System MPI INT 6.1K or MPI INT 6.1P:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Varnish matching topcoat.
c. First Intermediate Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

d. Second Intermediate Coat: Varnish matching topcoat.
e. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

f. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

g. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

7. Alkyd Varnish System MPI INT 6.1C:

a. Prime Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

b. Intermediate Coat: Varnish matching topcoat.
c. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

d. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

e. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

8. Polyurethane Varnish over Stain System MPI INT 6.1J:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

9. Polyurethane Varnish System MPI INT 6.1D:

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

d. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

10. Moisture-Cured Clear Polyurethane over Stain System MPI INT 6.1S:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss (MPI Gloss Level 6), MPI #31.

1) As directed.

11. Clear, Two-Component Polyurethane System MPI INT 6.1W:

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

1) As directed.

B. Wood Substrates: Exposed framing.

1. Water-Based Varnish over Stain System MPI INT 6.2M:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Water-based varnish matching topcoat.

c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

1) As directed.

e. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

f. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

2. Alkyd Varnish over Stain System MPI INT 6.2K:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

e. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

f. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

3. Alkyd Varnish System MPI INT 6.2P:

a. Prime Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

b. Intermediate Coat: Varnish matching topcoat.
c. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

d. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

e. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

4. Polyurethane Varnish over Stain System MPI INT 6.2J:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

5. Polyurethane Varnish System MPI INT 6.2H:

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

d. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

6. Moisture-Cured Clear Polyurethane over Stain System MPI INT 6.2N:

a. Stain Coat: Stain, semitransparent, for interior woo, MPI #90.

1) As directed.

b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss (MPI Gloss Level 6), MPI #31.

1) As directed.

7. Clear, Two-Component Polyurethane System MPI INT 6.2Q:

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

1) As directed.

C. Wood Substrates: As directed.

1. Semitransparent Stain System MPI INT 6.3C:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

1) As directed.

2. Water-Based Varnish over Stain System MPI INT 6.3W:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

1) As directed.

e. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

f. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

3. Water-Based Varnish System MPI INT 6.3Q:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

1) As directed.

d. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

e. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

4. Alkyd Varnish over Stain System MPI INT 6.3D:

    a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

        1) As directed.

    b. First Intermediate Coat: Alkyd, sanding sealer, clear, MPI #102.

        1) As directed.

    c. First Intermediate Coat: Shellac, clear, MPI #88.

        1) As directed.

    d. Second Intermediate Coat: Varnish matching topcoat.
    e. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

        1) As directed.

    f. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

        1) As directed.

    g. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

        1) As directed.

5. Alkyd Varnish System MPI INT 6.3J:

    a. Prime Coat: Alkyd, sanding sealer, clear, MPI #102.

        1) As directed.

    b. Prime Coat: Shellac, clear, MPI #88.

        1) As directed.

    c. Intermediate Coat: Varnish matching topcoat.
    d. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

        1) As directed.

    e. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

        1) As directed.

    f. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

        1) As directed.

6. Polyurethane Varnish over Stain System MPI INT 6.3E:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

7. Polyurethane Varnish System MPI INT 6.3K:

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

d. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

8. Moisture-Cured Clear Polyurethane over Stain System MPI INT 6.3Y:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss (MPI Gloss Level 6), MPI #31.

1) As directed.

9. Moisture-Cured Clear Polyurethane System MPI INT 6.3X:

a. Prime Coat: Moisture-cured polyurethane matching topcoat.
b. Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Topcoat: Varnish, polyurethane, moisture cured, gloss (MPI Gloss Level 6), MPI #31.

1) As directed.

10. Clear, Two-Component Polyurethane System MPI INT 6.3Z:

    a. Prime Coat: Two-component polyurethane matching topcoat.
    b. Intermediate Coat: Two-component polyurethane matching topcoat.
    c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

        1) As directed.

11. Danish Oil System MPI INT 6.3M:

    a. Prime Coat: Danish oil matching topcoat.
    b. Topcoat: Danish oil, MPI #92.

        1) As directed.

D. Wood Substrates: Wood paneling and casework.

1. Semitransparent Stain System MPI INT 6.4C:

    a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, semitransparent, MPI #13.

        1) As directed.

2. Water-Based Varnish over Stain System MPI INT 6.4U:

    a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

        1) As directed.

    b. First Intermediate Coat: Water-based varnish matching topcoat.
    c. Second Intermediate Coat: Water-based varnish matching topcoat.
    d. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

        1) As directed.

    e. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

        1) As directed.

    f. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

        1) As directed.

3. Water-Based Varnish System MPI INT 6.4M:

    a. Prime Coat: Water-based varnish matching topcoat.
    b. Intermediate Coat: Water-based varnish matching topcoat.
    c. Topcoat: Varnish, water based, clear, satin (MPI Gloss Level 4), MPI #128.

        1) As directed.

d. Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

1) As directed.

e. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.

1) As directed.

4. Alkyd Varnish over Stain System MPI INT 6.4D:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

c. First Intermediate Coat: Shellac, clear, MPI #88.

1) As directed.

d. Second Intermediate Coat: Varnish matching topcoat.
e. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

f. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

g. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

5. Alkyd Varnish System MPI INT 6.4G:

a. Prime Coat: Alkyd, sanding sealer, clear, MPI #102.

1) As directed.

b. Prime Coat: Shellac, clear, MPI #88.

1) As directed.

c. Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, interior, flat (MPI Gloss Level 1), MPI #73.

1) As directed.

e. Topcoat: Varnish, interior, semi-gloss (MPI Gloss Level 5), MPI #74.

1) As directed.

f. Topcoat: Varnish, interior, gloss (MPI Gloss Level 6), MPI #75.

1) As directed.

6. Polyurethane Varnish over Stain System MPI INT 6.4E:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Polyurethane varnish matching topcoat.
c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
d. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

e. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

7. Polyurethane Varnish System MPI INT 6.4J:

a. Prime Coat: Polyurethane varnish matching topcoat.
b. Intermediate Coat: Polyurethane varnish matching topcoat.
c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI #57.

1) As directed.

d. Topcoat: Varnish, interior, polyurethane, oil modified, gloss (MPI Gloss Level 6), MPI #56.

1) As directed.

8. Moisture-Cured Clear Polyurethane over Stain System MPI INT 6.4V:

a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.

1) As directed.

b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
d. Topcoat: Varnish, polyurethane, moisture cured, gloss (MPI Gloss Level 6), MPI #31.

1) As directed.

9. Danish Oil System MPI INT 6.4K:

a. Prime Coat: Danish oil matching topcoat.
b. Topcoat: Danish oil, MPI #92.

1) As directed.

END OF SECTION 099300

SECTION 099419 - MULTICOLOR INTERIOR FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of multicolor interior finishing systems. applied on the following substrates:

1. Vertical concrete.
2. Clay masonry units.
3. Concrete masonry units (CMU).
4. Wood.
5. Plaster.
6. Gypsum veneer plaster.
7. Gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MULTICOLOR FINISHING SYSTEMS

A. Master Painters Institute (MPI) Standards: Comply with recommendations in "MPI Architectural Painting Specification Manual" applicable to products and coating systems indicated.

B. Material Compatibility: Provide materials for use within each coating system that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

C. Colors and Patterns: Match Architect's samples, As selected by Architect from manufacturer's full range or as indicated in finish schedule.

2.2 MULTICOLOR COATINGS

A. Multicolor Coating: Water- or solvent-based coat that provides a decorative polychromatic finish.

2.3 FILLERS AND PRIMERS

A. Fillers, sealers, and primers recommended in writing for use in coating systems by manufacturer of multicolor interior coating on substrates and under conditions indicated.

B. Latex Block Filler: Waterborne, high-solids, emulsion-type, pigmented coating product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, with bridging and filling properties, and formulated for filling surfaces of CMU for subsequent applications of finish coatings.

C. Wood Filler Paste: Solvent-based, high-solids, clear paste product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating, for use on open-grained or damaged woods. The paste fills hardwood pores with minimal surface residues and without showing cracking or shrinkage. Sanding dried filler produces a smooth surface without clogging or gumming sandpaper.

D. Wood-Knot Sealer: White shellac or other sealer recommended in writing for this purpose by manufacturer of multicolor interior coating.

E. Primer/Sealer for Multicolor Systems: Acrylic or acrylic/polyvinyl acetate (PVA) co-polymer emulsion-type, pigmented primer/sealer product recommended in writing for use in coating system indicated by manufacturer of multicolor interior coating.

F. Interior Alkyd Primer/Sealer: Solvent-based, pigmented primer/sealer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

C. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content of surfaces or if alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

D. Wood Substrates:

1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view; remove sanding dust from surfaces to be coated.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried and remove sanding dust.

3.2 APPLICATION

A. Apply coatings according to manufacturer's written instructions using applicators and techniques suited for coating and substrate indicated.

B. Apply coating systems to produce uniformly textured, colored, and patterned finished-surface films without substrates, undercoats, marks, or stains showing through. Produce sharp, even glass lines and color breaks.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.3 MULTICOLOR INTERIOR FINISHING SCHEDULE

A. Vertical Concrete Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.

B. Clay Masonry Unit Substrates:

1. Prime Coat: Primer/sealer for multicolor systems tinted to match multicolor basecoat.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.

C. CMU Substrates:

1. Block Filler: Latex block filler.
2. Prime Coat: Primer/sealer for multicolor systems.
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.

D. Wood Substrates:

1. Fill Coat: Wood filler paste.
2. Prime Coat: Interior alkyd primer/sealer tinted to match multicolor base coat.
3. Multicolor Base Coat: Multicolor coating.
4. Multicolor Pattern Coat: Multicolor coating.

E. Gypsum Board Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.

F. Plaster Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.

G. Gypsum Veneer Plaster Substrates:

1. Prime Coat: Primer/sealer for multicolor systems.
2. Multicolor Base Coat: Multicolor coating.
3. Multicolor Pattern Coat: Multicolor coating.

END OF SECTION 099419

SECTION 099423 - GILDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gilding.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified gilding specialist. Experience applying metallic paint is insufficient experience for gilding.

B. Mockups: Provide mockups for each type of gilding and substrate indicated and each metallic leaf required to demonstrate aesthetic effects and set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

PART 2 - PRODUCTS

2.1 GILDING MATERIALS

A. Metallic Leaf: 12K gold (white gold), 18K gold, 22K gold, 23K gold, 23.5K gold, 23.5K red gold or Palladium as directed.

B. Sizing: Oil type.

PART 3 - EXECUTION

3.1 GILDING APPLICATION

A. Comply with manufacturer's written instructions for application methods unless otherwise indicated.

B. Apply gilding with adequate illumination that will not distort the condition of surfaces or materials being applied.

C. Apply sizing and metallic leaf to surfaces after substrate and nearby painting is completed and dry. Gently press metallic leaf into sizing with a soft brush or a cotton or velvet cloth to fully adhere it to the surface. Gently remove overlapped edges with a soft brush after the sizing has fully dried.

END OF SECTION 099423

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates: Revise lists below to suit Project.

1. Exterior Substrates:

a. Concrete, vertical and horizontal surfaces.
b. Clay masonry.
c. Concrete masonry units (CMUs).
d. Steel.
e. Galvanized metal.
f. Aluminum (not anodized or otherwise coated).
g. Wood.

2. Interior Substrates:

a. Concrete, vertical and horizontal surfaces.
b. Cement board.
c. Clay masonry.
d. Concrete masonry units (CMUs).
e. Steel.
f. Galvanized metal.
g. Aluminum (not anodized or otherwise coated).
h. Wood.
i. Gypsum board.
j. Plaster.

1.2 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals:

C. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: As directed Subject to compliance with requirements, provide product, provide one of the products or available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. Colors: As selected by Architect from manufacturer's full range, Match Architect's samples or as indicated in color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System MPI EXT 3.1D:

   a. Prime Coat: Epoxy, matching topcoat.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy-Modified Latex System MPI EXT 3.1E:

   a. Prime Coat: Epoxy-modified latex, matching topcoat.
   b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
   c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

   d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

3. Pigmented Polyurethane over Epoxy System MPI EXT 3.1M:

   a. Prime Coat: Epoxy, matching intermediate coat.
   b. Intermediate Coat: Epoxy, gloss, MPI #77.

   c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

B. Concrete Substrates, Horizontal Surfaces:

1. Epoxy Non-Slip Deck Coating System MPI EXT 3.2C:

   a. Prime Coat: As recommended in writing by topcoat manufacturer.
   b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
   c. Topcoat: Epoxy deck coating (slip resistant), MPI #82.

C. Clay Masonry Substrates:

1. Epoxy System MPI EXT 4.1D:

   a. Prime Coat: Epoxy, matching topcoat.
   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane over Epoxy System MPI EXT 4.1J:

   a. Prime Coat: Epoxy, matching intermediate coat.
   b. Intermediate Coat: Epoxy, gloss, MPI #77.

c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

D. CMU Substrates:

1. Epoxy System MPI EXT 4.2E:

a. Block Filler: Block filler, epoxy, MPI #116.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane over High-Build Epoxy System MPI EXT 4.2G:

a. Block Filler: Block filler, epoxy, MPI #116.

b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

E. Steel Substrates:

1. Epoxy System MPI EXT 5.1F:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy Deck Coating over Epoxy Primer and High-Build Epoxy System MPI EXT 5.1V:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

c. Topcoat: Epoxy deck coating, MPI #82.

3. Pigmented Polyurethane over Epoxy System MPI EXT 5.1H:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Epoxy, gloss, MPI #77.

c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

4. Pigmented Polyurethane over High-Build Epoxy System MPI EXT 5.1J:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

5. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System MPI EXT 5.1P:

a. Prime Coat: Primer, zinc rich, epoxy, MPI #20.

b. Intermediate Coat: Epoxy, gloss, MPI #77.

c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

6. Pigmented Polyurethane over Epoxy Zinc-Rich Primer and High-Build Epoxy System MPI EXT 5.1G:

a. Prime Coat: Primer, zinc rich, epoxy, MPI #20.

b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

F. Galvanized-Metal Substrates:

1. Epoxy System MPI EXT 5.3C:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane over Epoxy Primer System MPI EXT 5.3L:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

b. Intermediate Coat: Polyurethane, two component, pigmented, gloss matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

3. Pigmented Polyurethane over Vinyl Wash Primer and Epoxy Primer System MPI EXT 5.3D:

a. Prime Coat: Primer, vinyl wash, MPI #80.

b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

G. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System MPI EXT 5.4E:

a. Prime Coat: Primer, vinyl wash, MPI #80.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane over Epoxy System MPI EXT 5.4B:

a. Prime Coat: Primer, vinyl wash, MPI #80.

b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.
c. First and Second Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

H. Wood Substrates: Glued-laminated construction.

1. Pigmented Polyurethane System MPI EXT 6.1J:

a. Prime Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

I. Wood Substrates: Exposed framing.

1. Pigmented Polyurethane System MPI EXT 6.2J:

a. Prime Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

J. Wood Substrates: Wood trim, Architectural woodwork, Doors, Windows, Wood board siding and wood fences as directed

1. Pigmented Polyurethane System MPI EXT 6.3H:

a. Prime Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System MPI INT 3.1F:

    a. Prime Coat: Epoxy, matching topcoat.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 3.1P:

    a. Prime Coat: High-build epoxy, matching topcoat (reduced).
    b. Intermediate Coat: High-build epoxy, matching topcoat.
    c. Topcoat: High-build epoxy, low gloss, MPI #108.

    d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 3.1G:

    a. Prime Coat: Epoxy-modified latex, matching topcoat.
    b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
    c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

    d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

B. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System MPI INT 3.2C:

    a. Prime Coat: Epoxy, matching topcoat.
    b. Intermediate Coat: Epoxy, matching topcoat.
    c. Topcoat: Epoxy, gloss, MPI #77

2. Epoxy, High-Build System MPI INT 3.2L:

    a. Prime Coat: High-build epoxy, matching topcoat (reduced).
    b. Intermediate Coat: High-build epoxy, matching topcoat.
    c. Topcoat: High-build epoxy, low gloss, MPI #108.

    d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Pigmented Polyurethane System MPI INT 3.2D:

    a. Prime Coat: Epoxy, gloss, MPI #77.

    b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
    c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

4. Clear (Two-Component) Polyurethane System MPI INT 3.2K:

    a. Prime Coat: Two-component polyurethane matching topcoat.
    b. Intermediate Coat: Two-component polyurethane, matching topcoat.

c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

C. Cement Board Substrates:

1. Epoxy System MPI INT 3.3E:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy-Modified Latex System MPI INT 3.3D:

a. Prime Coat: Epoxy-modified latex, matching topcoat.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

D. Clay Masonry Substrates:

1. Epoxy System MPI INT 4.1F:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy-Modified Latex System MPI INT 4.1G:

a. Prime Coat: Epoxy-modified latex, matching topcoat.
b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

3. Clear (Two-Component) Polyurethane System MPI INT 4.1K:

a. Prime Coat: Two-component polyurethane, matching topcoat.
b. Intermediate Coat: Two-component polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

E. CMU Substrates:

1. Epoxy System MPI INT 4.2F or MPI INT 4.2G:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

b. Block Filler: Block filler, epoxy, MPI #116.

c. Intermediate Coat: Epoxy, matching topcoat.
d. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 4.2R:

   a. Prime Coat: Epoxy block filler, MPI #116.
   b. Intermediate Coat: High-build epoxy, matching topcoat.
   c. Topcoat: High-build epoxy, low gloss, MPI #108.

   d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 4.2J:

   a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

   b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
   c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

   d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

F. Steel Substrates:

1. Epoxy System MPI INT 5.1L:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, gloss, MPI #77.

2. High-Build Epoxy over Epoxy Zinc-Rich Primer System MPI INT 5.1P:

   a. Prime Coat: Primer, zinc-rich, epoxy, MPI #20.

   b. Intermediate Coat: Epoxy, high build, low gloss, MPI #108.

   c. Topcoat: Epoxy, gloss, MPI #77.

   d. Topcoat: Epoxy, high-build, low gloss, MPI #108.

3. Epoxy, High-Build System MPI INT 5.1Y:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: High-build epoxy, matching topcoat.
   c. Topcoat: High-build epoxy, low gloss, MPI #108.

   d. Topcoat: High-build epoxy, gloss, MPI #98.

4. Epoxy Deck Coating System MPI INT 5.1LL:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: Epoxy, gloss, MPI #77.

   c. Topcoat: Epoxy deck coating (slip resistant), MPI #82.

5. Epoxy-Modified Latex System MPI INT 5.1K:

   a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.

   b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
   c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

   d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

6. Pigmented Polyurethane over Epoxy Primer System MPI INT 5.1F:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: Polyurethane, two component, pigmented, matching topcoat.
   c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

7. Pigmented Polyurethane over High-Build Epoxy System MPI INT 5.1G:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: Epoxy, high build, MPI #108.

   c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

8. Pigmented Polyurethane over Epoxy Zinc-Rich and Epoxy System MPI INT 5.1J:

   a. Prime Coat: Primer, zinc rich, epoxy, MPI #20.

   b. Intermediate Coat: Epoxy, gloss, MPI #77.

   c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

G. Galvanized-Metal Substrates:

1. Epoxy over Epoxy Primer System MPI INT 5.3D:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   b. Intermediate Coat: Epoxy, matching topcoat.
   c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy over Vinyl Wash Primer and Epoxy Primer System MPI INT 5.3E:

   a. Prime Coat: Primer, vinyl wash, MPI #80.

   b. Intermediate Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101.

   c. Topcoat: Epoxy, gloss, MPI #77.

H. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Epoxy System MPI INT 5.4B:

a. Prime Coat: Primer, vinyl wash, MPI #80.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane System MPI INT 5.4C:

a. Prime Coat: Primer, vinyl wash, MPI #80.

b. Intermediate Coat: Epoxy, gloss, MPI #77.

c. Topcoat: Polyurethane, two-component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

I. Wood Substrates: Glued-laminated construction.

1. Epoxy System MPI INT 6.1L:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Pigmented Polyurethane System MPI INT 6.1E:

a. Prime Coat: Polyurethane, two component, pigmented, matching topcoat.
b. Intermediate Coat: Polyurethane, two component, pigmented, matching topcoat.
c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6), MPI #72.

J. Wood Substrates: Wood trim, Architectural woodwork, Doors, Windows and wood board paneling as directed.

1. Epoxy System MPI INT 6.3L:

a. Prime Coat: Epoxy, matching topcoat.
b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

K. Gypsum Board or Plaster Substrates as directed:

1. Epoxy System MPI INT 9.2E:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss, MPI #77.

2. Epoxy, High-Build System MPI INT 9.2N:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

b. Intermediate Coat: High-build epoxy, matching topcoat.
c. Topcoat: High-build epoxy, low gloss, MPI #108.

d. Topcoat: High-build epoxy, gloss, MPI #98.

3. Epoxy-Modified Latex System MPI INT 9.2F:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

d. Topcoat: Epoxy-modified latex, gloss (MPI Gloss Level 6), MPI #115.

END OF SECTION 099600

SECTION 099633 - HIGH-TEMPERATURE-RESISTANT COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of high-temperature-resistant coating systems on steel substrates.

1.2 DEFINITIONS

A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Sustainable Design Submittals: As directed.

C. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product, provide one of the products or available products that may be incorporated into the Work include, but are not

limited to products listed in High-Temperature-Resistant Coating Schedule for the category indicated.

2.2 HIGH-TEMPERATURE-RESISTANT COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. Colors: As selected by Architect from manufacturer's full range, Match Architect's samples or as indicated in color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

A. Apply high-temperature-resistant coating systems according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.

3.4 HIGH-TEMPERATURE-RESISTANT COATING SCHEDULE

A. Heat-Resistant Enamel System MPI EXT 5.2A and MPI INT 5.2A:

1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
2. Top Coat(s): Enamel, heat resistant (MPI Gloss Level 5 or 6), MPI #21.
    a. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer but not less than two.

B. Inorganic Zinc-Rich Coating System MPI EXT 5.2C and MPI INT 5.2C:

1. Prime Coat: Primer, zinc rich, inorganic, matching topcoat.
2. Top Coat(s): Primer, zinc rich, inorganic, MPI #19.
    a. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer but not less than two.

C. Heat-Resistant Aluminum Enamel System MPI EXT 5.2B and MPI INT 5.2B:

1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
2. Top Coat(s): Aluminum paint, enamel, heat resistant, MPI #2.
    a. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer but not less than two.

D. High-Heat-Resistant Coating System MPI EXT 5.2D and MPI INT 5.2D:

1. Prime Coat: Primer recommended in writing for use in coating system and under conditions indicated by manufacturer of topcoat.
2. Top Coat(s): Aluminum paint, high heat, MPI #22.
    a. Provide number of topcoats recommended in writing for use in coating system and under conditions indicated by manufacturer but not less than two.

END OF SECTION 099633

SECTION 099646 - INTUMESCENT PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of fire-retardant intumescent paint to interior and exterior items and surfaces.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals:

C. Samples: For each type of coating system and each color and gloss of intumescent paint finish indicated.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in the Exterior Intumescent Painting Schedule and Interior Intumescent Painting Schedule or comparable product by one of the following:

B. Products: Subject to compliance with requirements, provide product, provide one of the products or available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Intumescent Painting Schedule and Interior Intumescent Painting Schedule for the paint category indicated.

2.2 INTUMESCENT PAINT MATERIALS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Surface-Burning Characteristics of Fire-Retardant Systems: As tested according to ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or 75 or less.
2. Smoke-Developed Index: 450 or less.

C. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each material or coat, products and spreading rates shall be as recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.

D. Colors and Gloss: As selected by Architect from manufacturer's full range, Match Architect's samples or as indicated in a color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for surface treatments, shop-primed surfaces, maximum moisture content, and other conditions affecting performance of the Work.

B. Begin coating only when moisture content of wood substrate is 15 percent or less when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions, and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in the "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

A. General: Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for listing and labeling for surface-burning characteristics specified.

1. Finish doors on faces with intumescent finish. Paint tops, bottoms, and side edges with fire-inert finish.

3.4 EXTERIOR INTUMESCENT PAINTING SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Pigmented, Fire-Retardant System MPI EXT 6.1F:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, exterior, low sheen, MPI #126.

2. Clear, Fire-Retardant, Penetrating Wood Preservative System MPI EXT 6.1G:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-resistant sealer, for exterior wood, MPI #109.

B. Wood Substrates: Exposed framing.

1. Pigmented, Fire-Retardant System MPI EXT 6.2F:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, exterior, low sheen, MPI #126.

2. Clear, Fire-Retardant, Penetrating Wood Preservative System MPI EXT 6.2G:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.

c. Topcoat: Fire-resistant sealer, for exterior wood, MPI #109.

C. Wood Substrates: Wood trim, architectural woodwork and wood board siding as directed.

1. Pigmented, Fire-Retardant System MPI EXT 6.3P:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, exterior, low sheen, MPI #126.

2. Clear, Fire-Retardant, Penetrating Wood Preservative System MPI EXT 6.3Q:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-resistant sealer, for exterior wood, MPI #109.

D. Wood Substrates: Wood-based panel products.

1. Pigmented, Fire-Retardant System EXT 6.4E:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, exterior, low sheen, MPI #126.

2. Clear, Fire-Retardant, Penetrating Wood Preservative System MPI EXT 6.4F:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-resistant sealer, for exterior wood, MPI #109.

3.5 INTERIOR INTUMESCENT PAINTING SCHEDULE

A. Wood Substrates: Glued-laminated construction.

1. Pigmented, Fire-Retardant, Water-Based System MPI INT 6.1U:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, latex, interior, flat MPI #64.

d. Topcoat: Fire-retardant topcoat, latex, interior MPI #67.

2. Pigmented, Fire-Retardant, Solvent-Based System MPI INT 6.1UU:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, alkyd, interior, flat MPI #63.

3. Clear, Fire-Retardant, Water-Based System MPI INT 6.1V:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, interior, clear MPI #62.

4. Clear, Fire-Retardant, Solvent-Based System MPI INT 6.1VV:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, clear, alkyd, interior MPI #66.

B. Wood Substrates: Exposed framing.

1. Pigmented, Fire-Retardant, Water-Based System MPI INT 6.2F:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, latex, interior, flat MPI #64.

d. Topcoat: Fire-retardant topcoat, latex, interior MPI #67.

2. Pigmented, Fire-Retardant, Solvent-Based System MPI INT 6.2FF:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, alkyd, interior, flat MPI #63.

3. Clear, Fire-Retardant, Water-Based System MPI INT 6.2G:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, interior, clear MPI #62.

4. Clear, Fire-Retardant, Solvent-Based System MPI INT 6.2GG:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, clear, alkyd, interior MPI #66.

C. Wood Substrates: Wood trim, architectural woodwork and wood board paneling.

1. Pigmented, Fire-Retardant, Water-Based System MPI INT 6.3R:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, latex, interior, flat MPI #64.

d. Topcoat: Fire-retardant topcoat, latex, interior MPI #67.

2. Pigmented, Fire-Retardant, Solvent-Based System MPI INT 6.3RR:

a. Prime Coat: As recommended in writing by topcoat manufacturer.

b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, alkyd, interior, flat MPI #63.

3. Clear, Fire-Retardant, Water-Based System MPI INT 6.3S:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, interior, clear MPI #62.

4. Clear, Fire-Retardant, Solvent-Based System MPI INT 6.3SS:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, clear, alkyd, interior MPI #66.

D. Wood Substrates: Wood-based panel products.

1. Pigmented, Fire-Retardant, Water-Based System MPI INT 6.4P:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, latex, interior, flat MPI #64.

d. Topcoat: Fire-retardant topcoat, latex, interior MPI #67.

2. Pigmented, Fire-Retardant, Solvent-Based System MPI INT 6.4PP:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, alkyd, interior, flat MPI #63.

3. Clear, Fire-Retardant, Water-Based System MPI INT 6.4Q:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, interior, clear MPI #62.

4. Clear, Fire-Retardant, Solvent-Based System MPI INT 6.4QQ:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, clear, alkyd, interior MPI #66.

E. Wood Substrates: Wood shingles and shakes.

1. Pigmented, Fire-Retardant, Water-Based System MPI INT 6.6G:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, latex, interior, flat MPI #64.

d. Topcoat: Fire-retardant topcoat, latex, interior MPI #67.

2. Pigmented, Fire-Retardant, Solvent-Based System MPI INT 6.6GG:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, alkyd, interior, flat MPI #63.

3. Clear, Fire-Retardant, Water-Based System MPI INT 6.6H:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant coating, interior, clear MPI #62.

4. Clear, Fire-Retardant, Solvent-Based System MPI INT 6.6HH:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Fire-retardant topcoat, clear, alkyd, interior MPI #66.

END OF SECTION 099646

SECTION 099653 - ELASTOMERIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of elastomeric coatings to the following exterior substrates:

1. Concrete.
2. Concrete unit masonry.
3. Stucco.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of elastomeric coating indicated and in each color and gloss.

1.3 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements listed in the Elastomeric Coating Schedule for the paint category, as directed.

2.2 MATERIALS

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Moisture-Vapor Transmission: Minimum (As directed), based on testing according to ASTM D1653.

C. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

D. Colors: As directed.

E. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.

F. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.

G. Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.

B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.

C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in the "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

A. Apply elastomeric coatings according to manufacturer's written instructions.

B. Primers: Apply at a rate to ensure complete coverage.

C. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.

D. Elastomeric Finish Coat(s): As directed.

3.4 ELASTOMERIC COATING SCHEDULE

A. Concrete Substrates:

1. Elastomeric Coating System MPI EXT 3.1F:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating; MPI #113.

1) As directed.

d. Topcoat: Elastomeric, pigmented, exterior, water-based, nonflat coating; MPI #38.

1) As directed.

B. Concrete Unit Masonry Substrates:

1. Elastomeric Coating System MPI EXT 4.2D:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Block Filler: As recommended in writing by topcoat manufacturer.
c. Intermediate Coat: As recommended in writing by topcoat manufacturer.
d. Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating; MPI #113.

1) As directed.

C. Stucco Substrates:

1. Elastomeric Coating System MPI EXT 9.1C:

    a. Prime Coat: As recommended in writing by topcoat manufacturer.
    b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
    c. Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating; MPI #113.

        1) As directed.

    d. Topcoat: Elastomeric, pigmented, exterior, water-based, nonflat coating; MPI #38.

        1) As directed.

END OF SECTION 099653

SECTION 099726 - CEMENTITIOUS COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of cementitious coating systems on concrete and masonry.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Samples: In each color and gloss of topcoat.

1. Submit Samples on rigid backing, not less than 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of at least 100 sq. ft. (9.3 sq. m) of coating system indicated and each color and finish selected.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements listed in the Cementitious Coating Schedule for the paint category indicated, as directed.

2.2 CEMENTITIOUS COATINGS

A. Polymer-Modified Cementitious Coating: Containing portland cement, polymer, and hydrated lime or aggregates.

1. Compressive Strength: Not less than 3500 psi (24.1 MPa) at 28 days according to ASTM C109/C109M.
2. Tensile Strength: Not less than 350 psi (2.41 MPa) at 28 days according to ASTM C109/C109M.
3. Flexural Strength: As directed.
4. Adhesion: As directed.
5. Permeance: As directed.
6. Accelerated Weathering: As directed.
7. UV Resistance: As directed.
8. Salt-Spray Resistance: As directed.

B. Colors: As directed.

C. Other Materials: Provide crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.

B. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, incompatible coatings, and loose substrate materials.

D. Cementitious and Masonry Surfaces: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

A. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.

B. Apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:

1. First Coat: Apply polymer-modified cementitious coating material at the rate of 2 lb/sq. yd. (1 kg/sq. m) to achieve a total cured thickness of 25 mils (0.6 mm).
2. Second Coat: Apply polymer-modified cementitious coating material at the rate of 1 lb/sq. yd. (0.5 kg/sq. m) to achieve a total cured thickness of 15 mils (0.4 mm).

C. On previously coated surfaces, apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:

1. Apply polymer-modified cementitious coating material at the rate of 1 lb/sq. yd. (0.5 kg/sq. m) to achieve a total cured thickness of 15 mils (0.4 mm).

3.4 CEMENTITIOUS COATING SCHEDULE

A. Above-Grade Concrete and Masonry:

1. Polymer-Modified Cementitious Coating:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Polymer-modified cementitious coating.

1) As directed.

END OF SECTION 099726

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies.
2. Sliding visual display units.
3. Visual display conference units.
4. Glass markerboards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints

D. Samples: For each type of visual display unit indicated.

E. Product Schedule: For visual display units.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 50 years from date of Substantial Completion.
2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or 450 as directed or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

A. Visual Display Board Assembly: Field or factory fabricated.

1. Assembly: As directed.
2. Corners: Square or Rounded.
3. Width: As directed.
4. Height: As directed.

B. Chalkboard Panel: As directed -faced chalkboard panel on core indicated.

1. Color: As directed.

C. Markerboard Panel: As directed. Markerboard panel on core indicated.

1. Color: As directed.

D. Tackboard Panel: As directed. Tackboard panel on core indicated.

1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
2. Color and Pattern: As directed.

E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; as directed.

1. Field-Applied Trim: Manufacturer's standard, as directed.
2. Aluminum Finish: Finish as directed.

    a. Color: As directed

F. Factory-Applied Wood Trim: As directed, not less than 1/2 inch (13 mm) thick; as directed with opaque or transparent finish.

G. Vinyl Trim: Dark brown or Black. If locations of joints are critical, indicate them on Drawings and delete "Joints" Paragraph below.

H. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as directed.

I. Combination Assemblies: Provide as directed between abutting sections of visual display panels.

J. Chalktray: Manufacturer's standard; continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

K. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.

1. Size: As directed.
2. Map Hooks: Two map hooks for every 48 (1200) inches (mm) of display rail or fraction thereof.
3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 (1200) inches (mm) of display rail or fraction thereof.
4. Flag Holder: One for each room.
5. Tackboard Insert Color: As directed.
6. Aluminum Color: Match finish of visual display assembly trim.

L. Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.

2.3 SLIDING VISUAL DISPLAY UNITS

A. Horizontal-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed rear visual display panel, aluminum-framed horizontal-sliding visual display panels, and extruded-aluminum fascia that conceals overhead sliding track; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.

1. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall length of unit.
2. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-third or one-half of overall length of unit.
3. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface, and fixed front panel on each side of unit equal to not less than one-quarter of overall length of unit. Provide four sliding panels, each equal to not less than one-quarter of overall length of unit.

    a. Swinging Doors: Fabricated from same construction as sliding panels and supported on full-height continuous hinges. Provide visual display panel on both faces of each door.

4. Hardware: Manufacturer's standard, extruded-aluminum overhead track and channel-shaped bottom guides; with two nylon ball-bearing carriers and two nylon rollers for each sliding panel.

5. Overall Width: As directed.
6. Overall Height: As directed.

B. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed rear visual display panel, and aluminum-framed vertical-sliding panels; motor operated; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
   1. Type: Tubular frame on four sides or top and two sides, with sides extending to floor; with kick panel to conceal sliding panels. Design unit to support panels independently of wall.
   2. Two-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide two sliding panels, each equal to not less than one-half of overall height of unit.
   3. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-half of overall height of unit.
   4. Four-Track Units: Fabricate unit with fixed rear panel centered in and covering not less than one-half of rear surface. Provide four sliding panels, each equal to not less than one-half of overall height of unit.
   5. Hardware: Manufacturer's standard, neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with counterweights supported by steel aircraft cable over ball-bearing sheaves; with removable cover plate for access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.
   6. Motorized Operation: Provide not less than one motor with gearhead reducers for each sliding panel, mounted above visual display unit and connected to sliding panels with steel aircraft cable. Provide removable cover plate for access to motor. Equip motors with limit switches to automatically stop motor at each end of travel.

      a. Electric Motors: UL approved or recognized, totally enclosed, complying with NEMA MG 1, with thermal-overload protection; 1/15 hp, single phase, 110 or 220 V, 60 Hz.
      b. Control Station: Three-position, maintained or momentary contact, switch-operated control station with open, close, and off functions; with NEMA ICS 6, Type 1 enclosure. Provide one control station for each sliding panel unit.
      c. Key Switch: Provide supplementary key switch for each control station. Furnish two keys for each control station, keyed alike.

   7. Overall Width: As directed.
   8. Overall Height: As directed.

C. Panels and Accessories:

   1. Sliding Chalkboard Panel: Porcelain-enamel or High-pressure chalkboard laminate-faced chalkboard panel on kraft-paper honeycomb core designed to be rigid and to resist warpage, not less than 3/8 (9.5) inch (mm) thick.

      a. Color: As directed.

   2. Sliding Markerboard Panel: Porcelain-enamel or High-pressure markerboard laminate-faced markerboard panel on kraft-paper honeycomb core designed to be rigid and to resist warpage, not less than 3/8 (9.5) inch (mm) thick.

      a. Color: As directed.

3. Sliding Tackboard Panel: As directed tackboard panel on kraft-paper honeycomb core designed to be rigid and to resist warpage, not less than 3/8 (9.5) inch (mm) thick.

    a. Color and Pattern: As directed.

4. Fixed Rear Chalkboard Panel: Porcelain-enamel or High-pressure chalkboard laminate-faced chalkboard panel on core indicated.

    a. Color: As directed.

5. Fixed Rear Markerboard Panel: Porcelain-enamel or High-pressure markerboard laminate-faced markerboard panel on core indicated.

    a. Color: As directed.

6. Fixed Rear Tackboard Panel: Tackboard panel on core indicated as directed.

    a. Color and Pattern: As directed.

7. Kick Panel: Manufacturer's standard fabric-covered cork or low-pressure laminate.

    a. Color and Pattern: As directed.

8. Accessories: As directed.
9. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.

    a. Size: High by full length of visual display unit as directed
    b. Map Hooks: Two map hooks for every 48 (1200) inches (mm) of display rail or fraction thereof.
    c. Flag Holder: One for each sliding visual display unit.
    d. Tackboard Insert Color: As directed.

10. Aluminum Trim: Factory applied or Field applied; in manufacturer's standard size and profile; with clear anodic finish.

2.4 VISUAL DISPLAY CONFERENCE UNITS

A. Visual Display Conference Units: Factory-fabricated units consisting of hinged-door wood cabinet with perimeter face frame, sides, and back; not less than 3-inch (75-mm) interior depth and designed for surface wall mounting. Fabricate inside of cabinet and cabinet doors with fixed visual display units.

1. Wood Cabinets: Fabricated from solid wood with integral, solid-wood marker tray. Fabricate hinged door panels with solid-wood frame and wood-veneer exterior surface.

    a. Species and Finish: As directed.

2. Plastic-Laminate Cabinets: Cabinet and hinged door panels fabricated from manufacturer's standard wood panels finished with high-pressure decorative laminate; with integral marker tray.

    a. Color: As directed

3. Cabinet Corners: Square or Rounded.
4. Hardware: Manufacturer's standard, full-height continuous hinges, wire door pulls, and door bumpers.
5. Fixed Rear Panel: Manufacturer's standard markerboard panel.

    a. Color: As directed.

6. Inside Surface of Doors: Same as fixed rear panel.
7. Inside Surface of Doors: Tackboard panel consisting of facing on manufacturer's standard core.

    a. Color: As directed.

8. Width: 48 inches (1219 mm).
9. Height: As directed.
10. Accessories: Cylinder lock and flip-chart pad clamp.

2.5 GLASS MARKERBOARDS

A. Glass Markerboards: Fabricated of as directed glass with steel backing for use with magnets.

1. Edge Treatment: Smooth polished edge with rounded or eased corners.
2. Frame: Aluminum trim in profile indicated.
3. Surface: Glossy or Matte.
4. Color: As directed.

B. Mounting: Round, stainless steel standoffs, holding glass approximately 1 (25) inch (mm) from wall surface; mounted through holes in or in notches in standoffs at top and bottom edges of markerboard.

C. Mounting: Concealed, Z-shaped brackets.

D. Mounting: Manufacturer's standard adhesive or adhesive-foam tape mounting.

E. Graphics: Provide screen-printed graphics as indicated.

F. Marker Tray: Glass or Aluminum, attached with stainless steel clips or magnet.

G. Size: As directed.

2.6 CHALKBOARD PANELS

A. Porcelain-Enamel Chalkboard Panels: High-pressure factory-laminated chalkboard panels of balanced three-ply construction, consisting of moisture-barrier backing, core material, and

porcelain-enamel face sheet with matte finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch (0.53 mm) or 0.013 inch (0.33 mm) uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
3. Hardboard Core: 1/4 inch (6 mm) thick; with backing as directed.
4. Particleboard Core: 3/8 inch (9.5 mm) thick; with backing as directed.
5. Fiberboard Core: 3/8 inch (9.5 mm) or 1/2 inch (13 mm) thick; with backing as directed.
6. MDF Core: 7/16 inch (11 mm) thick; with manufacturer's standard moisture-barrier backing.
7. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

B. High-Pressure Chalkboard Laminate Panels: Factory-laminated chalkboard panels of balanced three-ply construction, consisting of backing, fiberboard core material, and high-pressure chalkboard laminate writing surface.

C. Melamine Chalkboard Panels: Fabricated from 1/4-inch- (6-mm-) thick, sealed and primed hardboard core permanently bonded with thermally fused, melamine-impregnated decorative paper writing surface complying.

2.7 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high or low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch (0.53 mm) or 0.013 inch (0.33 mm) uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
3. Hardboard Core: 1/4 inch (6 mm) thick; with backing as directed.
4. Particleboard Core: 3/8 inch (9.5 mm) or 1/2 inch (13 mm) thick; backing as directed.
5. Fiberboard Core: 3/8 inch (9.5 mm) or 1/2 inch (13 mm) thick; backing as directed.
6. MDF Core: 7/16 inch (11 mm) thick; with manufacturer's standard moisture-barrier backing.
7. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

B. High-Pressure Markerboard Laminate Panels: Factory-laminated markerboard panel of three-ply construction, consisting of backing, fiberboard core material, and high-pressure markerboard laminate writing surface.

C. Melamine Markerboard Panels: Fabricated from 1/4-inch- (6-mm-) thick, sealed and primed hardboard panels permanently bonded with thermally fused, melamine-impregnated decorative paper writing surface.

2.8 TACKBOARD PANELS

A. Tackboard Panels:

1. Facing: Natural cork or plastic-impregnated cork as directed.
2. Facing: Vinyl or Polyester fabric.
3. Facing: Vinyl or Polyester fabric factory laminated thick, cork sheet as directed.
4. Facing: Recycled rubber, 0.44 inch (11 mm) thick; with color flecks as directed.
5. Core: Manufacturer's standard.
6. Core: 3/8-inch- (9.5-mm-) or 7/16-inch- (11-mm-) thick fiberboard.
7. Core: 1/4-inch- (6-mm-) thick hardboard or particleboard.

2.9 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. High-Pressure Decorative Laminate: NEMA LD 3.

C. High-Pressure Markerboard Laminate: Complying with physical testing requirements of NEMA LD 3.

D. High-Pressure Chalkboard Laminate: Complying with physical testing requirements of NEMA LD 3.

E. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish; with surface-burning characteristics indicated.

F. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout; with surface-burning characteristics indicated.

G. Vinyl Fabric: Mildew resistant, washable, complying with ASTM F793/F793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface-burning characteristics indicated.

H. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.

I. Hardboard: ANSI A135.4, tempered.

J. Particleboard: ANSI A208.1, Grade M-1.

K. MDF: ANSI A208.2, Grade 130.

L. Fiberboard: ASTM C208 cellulosic fiber insulating board.

M. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

N. Extruded Aluminum: ASTM B221 or ASTM B221M, Alloy 6063.

O. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect or as indicated on approved Shop Drawings.
2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

C. Factory-Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg-size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.

D. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.

E. Sliding Visual Display Units: Install units at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches (400 mm) o.c.

F. Visual Display Conference Units: Install units at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface as directed.

END OF SECTION 101100

SECTION 101146 - VISUAL DISPLAY FABRICS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes dry-erase wall coverings.

1.2 ACTION SUBMITTALS

A. Product Data.

B. Sustainable Design Submittals.

C. Shop drawings.

D. Samples.

E. Product schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: As directed 50 or 450 or less.

2.2 DRY-ERASE WALL COVERINGS

A. Dry-Erase Wall Covering: As directed Intended for use with dry-erase markers and as a projection surface and consisting of low-gloss, moderate-gloss or high-gloss plastic film bonded to fabric backing.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

B. Magnetic Dry-Erase Wall Covering: Intended for use with dry-erase markers and magnetic aids and consisting of moderate-gloss plastic film bonded to ferrous-powdered fabric backing.
   1. Color: As indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from manufacturer's full range.

C. Adhesives for Field Application: Strippable, mildew-resistant, nonstaining adhesive for use with dry-erase wall coverings; and for substrate application; as recommended in writing by dry-erase wall covering manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Dry-Erase Wall Covering: Comply with dry-erase wall-covering manufacturers' written installation instructions.

END OF SECTION 101146

SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bulletin boards.
2. Display cases.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For display cases and bulletin boards.

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For fabrics and tackboard panels, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or 450 or less.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BULLETIN BOARDS

A. General: Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard panel on back inside surface and operable glazed doors at front.

1. Frame and Cabinet Profile: Square or Rounded frame section with square or rounded cabinet corners.
2. Mounting: Surface mounted or Recessed.
3. Size: As indicated on Drawings.
4. Size: 48 (1200) inches (mm) wide by 36 (910) inches (mm) high by 4 (100) inches (mm) deep.

B. Aluminum-Framed Cabinet: Extruded aluminum; with finish as directed.

1. Color: As directed.

C. Wood-Framed Cabinet: As directed.

D. Glazed Sliding Doors: Tempered glass or Clear acrylic sheet; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.

1. Number of Doors: As directed

E. Glazed Hinged Doors: Tempered glass or Clear acrylic sheet; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.

1. Number of Doors: As directed.

F. Back Panel: Manufacturer's standard Tackboard panel as directed.

1. Color: As directed

2.3 DISPLAY CASES

A. Unit in "Recessed Display Case" Paragraph below is also available from some manufacturers as front, face-frame component only, without cabinet, for installation with field-constructed recessed box. Revise text if retaining face-frame only. Several manufacturers offer semi-recessed display cases; revise Section Text if specifying semi-recessed display cases.

B. Recessed Display Case: Factory-fabricated display case; with finished interior, operable glazed doors at front, and trim on face to cover edge of recessed opening.

1. Display Case Cabinet: Extruded aluminum or Hardwood veneer plywood.

    a. Veneer Species: As directed.

2. Face Frame: Aluminum.
3. Face Frame: As directed.

4. Aluminum Finish: As directed.

    a. Color: As directed.

C. Surface-Mounted Display Case: Factory-fabricated display case; with finished interior, and glazed doors at front.

1. Construction: Hardwood-veneer-plywood bottom panel; glazed side panels; hardwood-veneer-plywood or glazed as directed top panel; aluminum or hardwood face frame as directed.

    a. Wood and Veneer Species: As directed

2. Construction: Extruded-aluminum top, bottom, and side panels.
3. Construction: Aluminum frame with glazed top, bottom, and side panels.
4. Construction: Hardwood frame; As directed.
5. Aluminum Finish: As directed.

    a. Color: As directed

6. Display Case Base: As directed.

D. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.

1. Number of Doors: As directed.

E. Glazed Hinged Doors: Tempered glass; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.

1. Number of Doors: As directed

F. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.

1. Shelf Depth: As directed.
2. Number of Shelves: Three.

G. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface or BHMA A156.9, B04071; with shelf rests, B04081; mounted on sides as directed. Provide standards extending full height of display case.

H. Natural-Cork Back Panel: Natural-cork tackboard panel.

I. Plastic-Impregnated Back Panel: Plastic-impregnated-cork tackboard panel.

J. Vinyl Back Panel: Vinyl-fabric-faced tackboard panel.

K. Polyester Back Panel: Polyester-fabric-faced tackboard panel.

L. Hardwood Back Panel: Hardwood veneer to match display case construction.

M. Back Panel: As directed.

1. Color: As directed.

N. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.

a. Electrical Characteristics: Single phase, 120 or 277 V.

2.4 MATERIALS

A. Hardboard: ANSI A135.4, tempered.

B. Fiberboard: ASTM C208.

C. Particleboard: ANSI A208.1, Grade M-1.

D. Hardwood Plywood: HPVA HP-1.

E. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.

F. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto burlap backing; with washable vinyl finish and integral color throughout.

G. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with flame-spread index of 25 or less when tested in accordance with ASTM E84.

H. Vinyl Fabric: ASTM F793/F793M, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with flame-spread index of 25 or less when tested in accordance with ASTM E84.

I. Extruded-Aluminum Bars and Shapes: ASTM B221 (ASTM B221M), Alloy 6063.

J. Aluminum Tubing: ASTM B429/B429M, Alloy 6063.

K. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

L. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colorless sheet with visible light transmittance of 92 percent measured in accordance with ASTM D1003.

M. Opaque Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet).

N. Translucent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished). Provide white-colored sheet unless otherwise indicated, of density required to produce uniform brightness and minimum halation effects.

O. High-Pressure Plastic Laminate: NEMA LD 3.

2.5 FABRICATION

A. Fabricate bulletin boards and display cases to requirements indicated for dimensions, design, and thickness and finish of materials.

B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.

C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Bulletin Boards: Attach units to wall surfaces with concealed clips, hangers, or grounds.

C. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches (600 mm) o.c.

D. Surface-Mounted Display Cases: Attach units to wall surfaces with concealed clips, hangers, or grounds fastened at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of display cases to walls.

E. Floor-Mounted Display Cases: Attach display cases with bases or legs to floor with concealed anchors.

END OF SECTION 101200

SECTION 101300 - DIRECTORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonilluminated message-strip directories.
2. Rear-illuminated message-strip directories.
3. Changeable-letter directories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For directories.

1. Include plans, elevations, sections, and attachment details.
2. Indicate layout directory, including header and message strips.
3. Include diagrams for power wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Message-Strip Schedule: For each message strip, indicating letter size, font, spacing, indents, text copy, and graphics.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each directory, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency as directed, for surface-burning characteristics of letterboards.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Message Strips: Full-size blank strips equal to 10 percent of number installed for each size indicated, but no fewer than 20 strips.
2. Paper Message-Strip Stock: Colored, perforated paper stock for printing paper message-strip inserts using manufacturer-supplied software, equal to 2 times message-strip capacity of directory.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or 450 or less as directed.

B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 NONILLUMINATED AND FRONT-ILLUMINATED MESSAGE-STRIP DIRECTORIES

A. Profiled Frame: Profiled frame at top and bottom, with sheet metal rear cover, housing changeable message strips in configuration indicated as directed.

1. Frame:

a. Top and Bottom Profile: A directed.
b. Side Trim: As directed.
c. Depth: Manufacturer's standard 1-1/2- to 2-1/2- (38- to 64-) inch (mm) frame depth.
d. Profile Face Dimension: 4 (100) or 6 (152) inches (mm) high as directed.
e. Aluminum Finish: As directed.
f. Color: As directed.

2. Cover: Removable, clear acrylic sheet held in place by perimeter frame. Provide suction cup tool for cover removal.
3. Number of Columns: Columns of message strips as directed.
4. Mounting: Surface.
5. Header: Copy applied to top section of profiled frame.
6. Divider Color: As directed.

B. Metal Frame: Directory with full perimeter metal frame and sheet metal rear cover, housing changeable message strips in configuration indicated.

1. Perimeter Frame:

a. Material: Extruded aluminum.
b. Profile: As directed.
c. Corners: Square or Radius as directed.
d. Depth: Manufacturer's standard 1-3/4- to 2-3/4- (44- to 70-) inch (mm) frame depth as directed.

2. Cover: Non-sectional single-piece cover with full-length concealed hinge, full width of directory or cover for each section of message strips with full-length concealed hinge as directed. Equip with cylinder lock(s).

a. Frame: Same material and finish as perimeter frame.
b. Hinge Location: As directed.
c. Glazing: As directed.

3. Number of Columns: Columns of message strips as directed.
4. Mounting: As directed.
5. Header Panel: Full width of directory, as directed.
6. Divider Strips: Provide divider strips between columns of message strips, and between header and message strips.

a. Color: As directed.

7. Aluminum Finish: As directed.

a. Color: As directed.

C. Message Strips: Provide message strips compatible with directory system selected, with message copy indicated in message-strip schedule.

1. Type:

a. Opaque flat plastic strips, which slide into retainer channels on sides of directory, with screen-printed or vinyl-film copy.
b. Acrylic or high-pressure plastic-laminate strips with machine- or laser-engraved copy, which exposes contrasting core.
c. Flexible magnetic tape with screen-printed or vinyl-film copy.
d. Film-Insert Changeable Message Strips: Removable message strips fabricated from plastic film with vinyl or screen-printed as directed lettering, held in interchangeable, interlocking plastic carriers.

2. Width: As directed.
3. Height: 1/2 (13) or 1 (25) inch (mm) as directed.
4. Color:

a. Message-Strip Background: As directed.
b. Lettering: As directed.

5. Lettering:

a. Letter Height: As directed.
b. Font Style: As directed.
c. Case: As directed.

6. Header Graphics: Provide copy that complies with requirements indicated on Drawings or artwork supplied on electronic media by Architect as directed for size, style, spacing, content, height, location, material, and colors of graphics.
7. Width: 24 inches (610 mm).
8. Height: 36 inches (914 mm).

D. Illumination System: Concealed top-lighting system consisting of fluorescent or LED fixtures. Include lamps and internal wiring with single, concealed electrical connection to building

system. Coordinate electrical characteristics with power supply provided. Provide angled message-strip section for more even illumination.

1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.
2. Electrical Characteristics: Single phase, 120 or 277 V as directed.

2.3 REAR-ILLUMINATED MESSAGE-STRIP DIRECTORIES

A. Rear-Illuminated Message-Strip Directory: Factory-fabricated unit consisting of changeable message strips held in place by retainer frame enclosed in manufacturer's standard 4-to-6-inch- (100-to-150-mm-) deep perimeter frame; with glazed cover, aluminum-sheet rear cover panel, and concealed rear-illumination system.

1. Frame:

    a. Material: Extruded aluminum.
    b. Profile: As directed.
    c. Corners: Square or Radius as directed.

2. Cover: Non-section, one-piece cover with concealed lock.

    a. Cover Frame Material: Same material and finish as perimeter frame.
    b. Cover Frame Profile: As directed
    c. Hinge Location: As directed.
    d. Glazing: As directed.

3. Header Panel: Same material and color as changeable message strips. Provide copy that complies with requirements indicated on Drawings or artwork supplied on electronic media by Architect as directed for size, style, spacing, content, height, location, material, and colors of graphics.
4. Divider Color: Same as message strips.
5. Film-Insert Message Strips: Removable, black, film-negative message strips in 7-inch- (175-mm-) or 14-inch- (350-mm-) long, interchangeable, interlocking plastic carriers as directed.
6. Engraved Changeable Message Strips: Machine- or laser-engraved copy in 7-inch- (175-mm-) or 14-inch- (350-mm-) long, interchangeable, interlocking, black, acrylic strips with transparent core as directed.

    a. Message-Strip Height: As directed.
    b. Letter Height: As directed.
    c. Letter Style: As directed.
    d. Letter Case: As directed.

7. Rear-Illumination System: Provide removable and accessible fluorescent-strip or LED fixture system with reflective interior surfaces for uniform illumination of message strips and header panel with minimum halation and without light leaks. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

a. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.
b. Electrical Characteristics: Single phase, 120 or 277 V as directed.

8. Aluminum Finish: As directed.

a. Color: As directed.
b. Plating: As directed.

9. Width: As directed.
10. Height: As directed.
11. Mounting: As directed

2.4 CHANGEABLE-LETTER DIRECTORIES

A. Enclosed-Face, Changeable-Letter Directory: Factory-fabricated unit consisting of manufacturer's standard, 2-inch- (50-mm-) deep, perimeter frame with fixed or removable letterboard as directed on back inside surface and with glazed doors or lift-off, glazed cover as directed.

1. Aluminum Perimeter Frame: Extruded aluminum.

a. Perimeter Frame Profile: As directed
b. Perimeter Frame Corners: Square or Radius as directed.
c. Finish: As directed.

1) Color: As directed.

2. Wood Perimeter Frame: Red oak or Walnut with finish as directed.

a. Perimeter Frame Profile: As directed.
b. Perimeter Frame Corners: Square or Radius as directed.

3. Glazed Sliding Doors: Unframed, clear-tempered-glass doors supported on nylon or ball-bearing rollers in extruded-aluminum top and bottom track, with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.

a. Door Track: Same finish on exposed surfaces as perimeter frame.
b. Number of Doors: Two or Three as directed.

4. Glazed Hinged Doors: Clear acrylic sheet or tempered glass set in door frame equipped with full-height continuous hinge and cylinder lock with two keys.

a. Door Frame: Same material and finish as perimeter frame.
b. Number of Doors: As directed

5. Lift-off Cover: Clear acrylic sheet or tempered glass as directed set in frame that snaps into place. Fabricate frame from same material and finish as perimeter frame.

6. Letterboard: Manufacturer's standard covered panel material, with grooves spaced at 1/4 inch (6 mm) o.c. to receive changeable letters as directed.

    a. Color: Black or Red as directed.

7. Letters: Molded plastic with tabs for engaging grooves in letterboard. Provide manufacturer's standard assortment of not less than 300 characters for each size, style, color, and case required; include letters, numbers, and characters. Package letters in compartmentalized carrying box.

    a. Height: To top of capitals as directed.
    b. Style: As directed.
    c. Color: White or Black as directed.
    d. Case: All capitals or Capitals and lowercase as directed.

8. Width: 24 inches (610 mm).
9. Height: 36 inches (914 mm).
10. Mounting: As directed.
11. Illumination System: Concealed top-lighting system consisting of fluorescent or LED fixtures. Include lamps and internal wiring with single, concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.

    a. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.
    b. Electrical Characteristics: Single phase, 120 or 277 V as directed.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

    1. Sheet: ASTM B209 (ASTM B209M).
    2. Extruded Shapes: ASTM B221 (ASTM B221M), Alloy 6063.

B. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3.

C. Gray-Tinted Float Glass: ASTM C1036; Type I (transparent glass, flat); Class 2 (tinted, heat absorbing, and light reducing), Quality q3 (glazing select); gray-tinted monolithic glass with a maximum luminous transmittance of 14 percent.

D. Bronze-Tinted Float Glass: ASTM C1036; Type I (transparent glass, flat); Class 2 (tinted, heat absorbing, and light reducing), Quality q3 (glazing select); bronze-tinted monolithic glass with a maximum luminous transmittance of 44 percent.

E. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality q3, with exposed edges seamed before tempering.

F. Tinted Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 2 (tinted), tint as indicated, Quality q3, with exposed edges seamed before tempering.

G. Clear Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colorless sheet with visible light transmittance of 92 percent measured in accordance with ASTM D1003.

H. Bronze-Tinted Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished).

I. Translucent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), white-colored sheet of density required to produce uniform brightness and minimum halation effects.

J. Opaque Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colors as indicated.

2.6 FABRICATION

A. Fabricate directories to requirements indicated for dimensions, design, and thickness and finish of materials. Use metals and shapes of thickness and reinforcement to produce flat surfaces, free of oil canning, and to impart strength for size, design, and application indicated.

B. Fabricate directory cabinets and door frames with reinforced corners, mitered and welded to a hairline fit, with no exposed fasteners. Provide structural reinforcement to prevent racking and misalignment.

C. Message-Strip Directories: Provide blank message strips for each carrier in entire directory.

D. Message-Strip Directories: Provide message strips with wording and other designations for locations where wording is indicated. Include blank message strips as needed to fill out remainder of directory.

E. Provide hold-open arms for doors of top-hinged directories.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611 or thicker as directed.

B. Color Anodic Finish: AAMA 611 or thicker as directed.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install directories with perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Mounting Height: Install directories at mounting heights indicated on Drawings, or if not indicated, at 72 (1829) inches (mm) above finished floor to top of directory.

C. Recessed Directories: Attach directories to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed directories, and conceal grounds and clips.

D. Surface-Mounted Directories: Attach directories to wall framing with concealed clips, hangers, or grounds fastened at not more than 16 inches (400 mm) o.c. Secure both top and bottom of directories to walls.

E. Comply with requirements specified elsewhere for connecting illuminated directories.

3.2 ADJUSTING AND CLEANING

A. Adjust directory doors to operate smoothly without warp or bind and so that contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 101300

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal plaques.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1 As directed.

2.2 PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Plaque Material: As directed Cast aluminum, brass, bronze or zinc.
   2. Plaque Thickness: As directed 0.153 inch (3.89 mm), 0.25 inch (6.35 mm) or 0.50 inch (12.7 mm).
   3. Finishes:
      a. Integral Metal Finish: Mill, Antique oxidized, Mill finish raised surface with dark oxidized background, as indicated by manufacturer's designation, Match Architect's sample or As selected by Architect from full range of industry finishes.
      b. Integral Aluminum Finish: Clear anodized, Light bronze anodized, Medium bronze anodized, Match Architect's sample or Anodized color as selected by Architect from full range of industry colors and color densities.
      c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as indicated by manufacturer's designation, matching Architect's sample or as selected by Architect from manufacturer's full range.
      d. Overcoat: Manufacturer's standard baked-on clear coating.
   4. Background Texture: Smooth, Pebble, Leatherette, Matte, Stipple, Match Architect's sample or As selected by Architect from manufacturer's full range.
   5. Integrally Cast Border Style: As indicated on Drawings, Square cut without border, Square single line, polished, Square double line, polished, Plain bevel, brushed, Plain bevel, polished, Projected bevel, Raised flat band or Double-raised line border.
   6. Mounting: As indicated on Drawings, Concealed studs, Rosette-head through fasteners, Countersunk flathead through fasteners or Adhesive.

B. Etched Plaque: Chemically etched or photochemically engraved metal sheet or plate with texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Plaque Material: Sheet or plate aluminum, brass, bronze, copper or stainless steel or zinc.
   2. Plaque Thickness: As directed 0.064 inch (1.63 mm), 0.125 inch (3.18 mm), 0.153 inch (3.89 mm) or 0.250 inch (6.35 mm).
   3. Finishes:
      a. Integral Metal Finish: As directed Mill, Antique oxidized, Mill finish raised surface with dark oxidized background, as indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry finishes.

b. Integral Aluminum Finish: As directed Clear anodized, Light bronze anodized, Medium bronze anodized, Match Architect's sample or Anodized color as selected by Architect from full range of industry colors and color densities.
c. Integral Stainless-Steel Finish: No. 4, No. 8, Match Architect's sample or as selected by Architect from full range of industry finishes.
d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as indicated by manufacturer's designation, matching Architect's sample or as selected by Architect from manufacturer's full range.
e. Overcoat: Manufacturer's standard baked-on clear coating.

4. Integral Edge Style: As indicated on Drawings, Square cut, polished or Plain bevel, brushed.
5. Mounting: As indicated on Drawings, Concealed studs, Rosette-head through fasteners, Countersunk flathead through fasteners or Adhesive.

2.3 MATERIALS

A. Brass Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated, lead-free alloy recommended by manufacturer and finisher for finish indicated or Alloy UNS No. C85200 (high-copper yellow brass).

B. Brass Sheet (Yellow Brass): ASTM B36/B36M, alloy recommended by manufacturer and finisher for finish indicated, lead-free alloy recommended by manufacturer and finisher for finish indicated or Alloy UNS No. C26000 (yellow brass).

C. Bronze Castings: ASTM B584, alloy recommended by manufacturer and finisher for finish indicated, lead-free alloy recommended by manufacturer and finisher for finish indicated or Alloy UNS No. C86500 (No. 1 manganese bronze).

D. Bronze Plate: ASTM B36/B36M, alloy recommended by manufacturer and finisher for finish indicated, lead-free alloy recommended by manufacturer and finisher for finish indicated or Alloy UNS No. C22000 (commercial bronze).

E. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316, stretcher-leveled standard of flatness.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal, stainless-steel or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Plaque Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by plaque manufacturer.
    1. As directed.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

    1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
    2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
    3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
    4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
    5. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.

    1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

    1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match plaque-background color or to match Architect's sample color unless otherwise indicated.
    2. Stainless-Steel Brackets: Factory finish brackets to match plaque background, to match Architect's sample or with No. 4 finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as plaques are installed.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast dimensional characters.
2. Cutout dimensional characters.
3. Fabricated channel dimensional characters.
4. Illuminated, fabricated channel dimensional characters.
5. Molded-plastic dimensional characters.
6. Illuminated, molded-plastic dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of rooftop sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces or as directed.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
1. Character Material: Cast as directed.
2. Character Height: As directed.
3. Finishes:

a. Integral Metal Finish: Mill or Antique oxidized or as directed.
b. Integral Aluminum Finish: As directed.
c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as directed.
d. Overcoat: Manufacturer's standard baked-on clear coating.

4. Mounting: As directed.

B. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
1. Character Material: Sheet or plate or as directed.
2. Character Height: As directed.
3. Thickness: 0.125 inch (3.18 mm) or 0.25 inch (6.35 mm) as directed.
4. Finishes:

a. Integral Metal Finish: Mill or Antique oxidized or as directed.
b. Integral Aluminum Finish: As directed.
c. Integral Stainless-Steel Finish: No. 4 or No. 8 as directed
d. Integral Acrylic Color: As directed.
e. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as directed.
f. Overcoat: As directed

5. Mounting: As directed.

C. Fabricated Channel Characters formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows as directed.
1. Illuminated Characters: Backlighted or Frontlighted as directed character construction with as directed lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.

a. Power: As directed

2. Character Material: Sheet or plate aluminum.
3. Translucent Face Sheet: Acrylic sheet with integral color as directed.
4. Character Height: As directed.
5. Character Depth: As directed.
6. Finishes:

a. Integral Metal Finish: Mill or Antique oxidized as directed.
b. Integral Aluminum Finish: As directed
c. Integral Stainless-Steel Finish: No. 4 or No. 8 as directed.
d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as directed.
e. Overcoat: As directed.

7. Mounting: As directed.

a. Hold characters at as directed from wall surface.

D. Molded-Plastic Characters: Characters having uniform faces and profiles, and as follows:
1. Illuminated Characters: Characters with concealed lighting, including transformers, insulators, and other accessories; with provision for servicing and concealing connections to building electrical system as directed. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.

a. Power: 120 V, 60 Hz, 1 phase, 15 A or as directed.

2. Color: Manufacturer's standard integral color or painted finish process, in color as directed.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Brass Castings: ASTM B584 or as directed.

B. Brass Sheet (Yellow Brass): ASTM B36/B36M or as directed.

C. Bronze Castings: ASTM B584 or as directed.

D. Bronze Plate: ASTM B36/B36M or as directed.

E. Copper Sheet: ASTM B152/B152M.

F. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 or Type 316 or as directed stretcher-leveled standard of flatness.

G. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish as directed devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
2. Stainless-Steel Brackets: Factory finish brackets unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs.
2. Illuminated panel signs.

B. Related Requirements:

1. Section 101423.16 "Room-Identification Panel Signage" for room-identification signs that are directly attached to the building.
2. Section 101426 "Post and Panel/Pylon Signage" for freestanding signs.
3. Section 265213 "Emergency and Exit Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of rooftop or illuminated panel sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" or the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PANEL SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Illuminated Panel Sign: As directed Backlighted or Edgelighted construction with fluorescent tube, fiber-optic, LED or neon tube lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.

a. Power: As indicated on electrical Drawings or 120 V, 60 Hz, 1 phase, 15 A.

2. Solid-Sheet Sign and Returns, Returns, and Back: As directed Aluminum, Stainless-steel, Acrylic, Fiberglass or PVC sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:

   a. Surface-Applied, Flat Graphics: As directed Applied vinyl film, baked enamel or powder coat, paint or photo image.
   b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
   c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
   d. Inset, Cutout Characters: As directed Sign face routed to receive push-through acrylic graphics flush with or slightly projecting from the sign panel.

3. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of acrylic or phenolic core sheet with painted edges.

   a. Surface-Applied, Flat Graphics: As directed Applied vinyl film, paint or photo image.
   b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

4. Laminated-Sheet Sign: As directed Photopolymer or Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic or phenolic backing sheet to produce composite sheet.

   a. Surface-Applied, Flat Graphics: As directed Applied vinyl film, paint or photo image.
   b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
   c. Subsurface Graphics: As directed Reverse halftone or dot-screen image, Reverse etch image, Snap-in changeable insert beneath removable face sheet or Slide-in changeable insert.

5. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.

   a. Surface-Applied, Flat Graphics: As directed Applied vinyl film, paint or photo image.
   b. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
   c. Subsurface Graphics: Reverse halftone or dot-screen image or Reverse etch image.

6. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.

   a. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
   b. Plastic-Laminate Color and Pattern: As indicated by manufacturer's designation or as selected by Architect from manufacturer's full range.

7. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition at Vertical Edges at Horizontal Edges: As indicated on Drawings, Square cut, Beveled or Bullnosed.
b. Corner Condition in Elevation: As indicated on Drawings, Square or Rounded to radius indicated.

8. Frame: As directed Entire perimeter, Horizontal retainers, Vertical retainers or to hold changeable sign panel.

a. Material: As directed Aluminum, Brass, Bronze, Steel, Stainless steel or PVC.
b. Profile: As directed Square, Beveled or Rounded.
c. Corner Condition in Elevation: As directed Square, Mitered or Rounded to radius indicated.
d. Finish and Color: Mill, Painted, matte black color, Match Architect's sample or As selected by Architect from manufacturer's full range.

9. Mounting: As indicated on Drawings, Manufacturer's standard method for substrates indicated, Surface mounted to wall, Projecting from wall, Suspended, Aluminum bracket or Stainless-steel bracket with concealed anchors, countersunk flathead through fasteners, adhesive, two-face tape, hook-and-loop tape or magnetic tape.
10. Surface Finish and Applied Graphics:

a. Integral Metal Finish: As directed Mill, Antique oxidized, As indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry finishes.
b. Integral Aluminum Finish: As directed Clear anodized, Light bronze anodized, Medium bronze anodized, Match Architect's sample or Anodized color as selected by Architect from full range of industry colors and color densities.
c. Integral Stainless-Steel Finish: As directed No. 4, No. 8, Match Architect's sample or as selected by Architect from full range of industry finishes.
d. As directed Integral Acrylic, Fiberglass or PVC Sheet Color: As indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry colors.
e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as indicated by manufacturer's designation, matching Architect's sample or as selected by Architect from manufacturer's full range.
f. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint or acrylic polyurethane, in color as indicated by manufacturer's designation or matching Architect's sample as selected by Architect from manufacturer's full range.
g. Photo-Image Graphics: Manufacturer's standard black-and-white, multicolor, 600-dpi halftone or dot-screen image.
h. Overcoat: Manufacturer's standard baked-on clear coating.

2.3 PANEL-SIGN MATERIALS

A. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316, stretcher-leveled standard of flatness.

B. Acrylic Sheet: ASTM D4802, Type UVF (UV filtering).

C. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.

D. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal, stainless-steel or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
    c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing signs with imposed loads to structure.
2. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Adhesive: As recommended by sign manufacturer.

E. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

F. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color or to match Architect's sample color unless otherwise indicated.
2. Stainless-Steel Brackets: As directed Factory finish brackets to match sign background, to match Architect's sample or with No. 4 finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate and install washers and nuts on stud ends projecting through opposite side of surface and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

B. Related Requirements:

1. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions as directed.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign or Sign system or as directed with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Photopolymer or Sandblasted polymer face sheet with raised graphics laminated over subsurface graphics to acrylic or phenolic backing sheet to produce composite sheet as directed.

    a. Composite-Sheet Thickness: 0.125 inch (3.18 mm) or 0.25 inch (6.35 mm) as directed.
    b. Surface-Applied Graphics: Applied as directed.
    c. Subsurface Graphics: As directed.
    d. Color(s): As directed.

2. Sign-Panel Perimeter: Finish edges smooth.

    a. Edge Condition at Vertical Edges or at Horizontal Edges: As directed.
    b. Corner Condition in Elevation: Square or Rounded to radius indicated as directed.

3. Frame: As directed.

    a. Material: Aluminum.
    b. Profile: As directed.
    c. Corner Condition in Elevation: As directed.
    d. Finish and Color: As directed.

4. Mounting: Manufacturer's standard method for substrates indicated or Surface mounted to wall with concealed anchors or as directed.

2.3 SIGN MATERIALS

A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish devices unless otherwise indicated as directed.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.

3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

END OF SECTION 101423.16

SECTION 101426 - POST AND PANEL/PYLON SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonilluminated post-and-panel signs.
2. Internally illuminated post-and-panel signs.
3. Nonilluminated pylon signs.
4. Internally illuminated pylon signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signage.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of post-and-panel or pylon sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 POST-AND-PANEL SIGNS

A. Post-and-Panel Sign: As directed Sign of single-panel or hollow-box configuration; with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Illuminated Sign: As directed Backlighted or Edgelighted construction with fluorescent tube, fiber-optic, LED or neon tube lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.

a. Power: As indicated on electrical Drawings or 120 V, 60 Hz, 1 phase, 15 A.

2. Solid-Sheet Sign Panels and Returns, Returns, and Back: As directed Aluminum, Stainless-steel, Acrylic, Fiberglass or Polycarbonate sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph and as follows:

a. Surface-Applied Graphics: As directed Applied vinyl film, baked enamel or powder coat, paint or photo image.
b. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
c. Inset, Cutout Characters: As directed Sign face routed to receive push-through acrylic graphics flush with or slightly projecting from the sign panel.

3. Laminated, Aluminum-Sheet Sign Panels: As directed Aluminum sheet laminated to both sides of acrylic or phenolic core sheet with painted edges.

   a. Surface-Applied Graphics: As directed Applied vinyl film, paint or photo image.

4. Single-Panel Sign Frame: As directed Entire perimeter, Horizontal retainers or Vertical retainers.

   a. Material: As directed Aluminum or Stainless steel.
   b. Profile: As directed Square, Beveled or Rounded.
   c. Corner Condition in Elevation: As directed Square, Mitered or Rounded to radius indicated.
   d. Finish and Color: As directed Mill, Black baked enamel or powder coat, Match sign-panel face, Match Architect's sample or As selected by Architect from manufacturer's full range.

5. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.

   a. Hollow-Box Depth: As directed 2 inches (50 mm), 6 inches (150 mm) or Same depth as posts.
   b. Profile: As directed Square, Beveled or Rounded.
   c. Corner Condition in Elevation: As directed Square, Mitered or Rounded to radius indicated.
   d. Finish and Color: Mill, Black baked enamel or powder coat, Match sign-panel face, Match Architect's sample or as selected by Architect from manufacturer's full range.

6. Multiple-Message Bars and Inserts: Fixed message bars capable of receiving changeable messages in the form of slide-in, aluminum or acrylic-sheet changeable inserts.Provide initial messages as indicated on Drawings.
7. Posts: As directed Aluminum or Steel.

   a. Shape: As directed Round, Square, Rectangular or Semicircular.
   b. Size: As directed 2-inch (50-mm) diameter, 3-inch (75-mm) diameter, 4-inch (100-mm) diameter, 2 by 2 inches (50 by 50 mm), 3 by 3 inches (75 by 75 mm), 4 by 4 inches (100 by 100 mm), 2 by 4 inches (50 by 100 mm) or 1-3/4 by 3 inches (44 by 75 mm).
   c. Installation Method: As directed Direct burial, Baseplate, Sleeve or Reverse sleeve.

d. Finish and Color: As directed Mill, Black baked enamel or powder coat, Match sign-panel face, Match sign-panel frame, Match Architect's sample or as selected by Architect from manufacturer's full range.

8. Sign-Panel-Face Finish and Applied Graphics:

a. Integral Metal Finish: As directed Mill, Antique oxidized, Mill finish raised surface with dark oxidized background, as indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry finishes.
b. Integral Aluminum Finish: Clear anodized, Light bronze anodized, Medium bronze anodized, Match Architect's sample, Anodized color as selected by Architect from full range of industry colors and color densities.
c. Integral Stainless-Steel Finish: No. 4, No. 8, Match Architect's sample or as selected by Architect from full range of industry finishes.
d. Integral Acrylic, Fiberglass or Polycarbonate Sheet Color: As indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry colors.
e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.
f. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint or acrylic polyurethane, in color as indicated by manufacturer's designation, matching Architect's sample or as selected by Architect from manufacturer's full range.
g. Photo-Image Graphics: Manufacturer's standard black-and-white, multicolor, 600-dpi halftone or dot-screen image.
h. Overcoat: Manufacturer's standard baked-on clear coating.

2.3 PYLON SIGNS

A. Pylon Sign: Sign with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Illuminated Sign: Backlighted or Edgelighted construction with fluorescent tube, fiber-optic, LED or neon tube lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.

a. Power: As indicated on electrical Drawings or 120 V, 60 Hz, 1 phase, 15 A.

2. Solid-Sheet Sign Panels and Returns, Returns, and Back: Aluminum, Stainless-steel, Acrylic, Fiberglass or Polycarbonate sheet with finish specified in "Sign-Panel-Face Finish and Applied Graphics" Subparagraph and as follows:

a. Surface-Applied Graphics: As directed Applied vinyl film, baked enamel or powder coat, paint or photo image.

b. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
c. Inset, Cutout Characters: As directed Sign face routed to receive push-through acrylic graphics flush with or slightly projecting from the sign panel.

3. Laminated, Aluminum-Sheet Sign Panels: Aluminum sheet laminated to both sides of acrylic or phenolic core sheet with painted edges.

   a. Surface-Applied Graphics: Applied vinyl film, paint or photo image.

4. Single-Panel Sign Frame: As directed Entire perimeter, Horizontal retainers or Vertical retainers.

   a. Material: As directed Aluminum or Stainless steel.
   b. Profile: As directed Square, Beveled or Rounded.
   c. Corner Condition in Elevation: As directed Square, Mitered or Rounded to radius indicated.
   d. Finish and Color: As directed Mill, Black baked enamel or powder coat, Match sign-panel face, Match Architect's sample or as selected by Architect from manufacturer's full range.

5. Hollow-Box Sign Frame: Entire perimeter framed with formed-aluminum sheet or extruded-aluminum, hollow-box-type frame with vertical edges attached to supports with aluminum fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.

   a. Hollow-Box Depth: As directed 2 inches (50 mm), 6 inches (150 mm) or Same depth as external pylon frame.
   b. Profile: As directed Square, Beveled or Rounded.
   c. Corner Condition in Elevation: As directed Square, Mitered or Rounded to radius indicated.
   d. Finish and Color: As directed Mill, Black baked enamel or powder coat, Match sign-panel face, Match Architect's sample or as selected by Architect from manufacturer's full range.

6. Multiple-Message Bars and Inserts: Fixed message bars capable of receiving changeable messages in the form of slide-in, aluminum or acrylic-sheet changeable inserts. Provide initial messages as indicated on Drawings.
7. Pylon Structure: As directed Internal or External frame.

   a. Pylon Shape: As directed Rectangular, Square, Triangular or Circular.
   b. External-Frame Finish and Color: As directed Mill, Black baked enamel or powder coat, Match sign-panel face, Match sign-panel frame, Match Architect's sample or as selected by Architect from manufacturer's full range.

8. Sign-Panel-Face Finish and Applied Graphics:

   a. Integral Metal Finish: As directed Mill, Antique oxidized, Mill finish raised surface with dark oxidized background, as indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry finishes.

b. Integral Aluminum Finish: Clear anodized, Light bronze anodized, Medium bronze anodized, Match Architect's sample or Anodized color as selected by Architect from full range of industry colors and color densities.
c. Integral Stainless-Steel Finish: As directed No. 4, No. 8, Match Architect's sample or as selected by Architect from full range of industry finishes.
d. Integral As directed Acrylic, Fiberglass or Polycarbonate Sheet Color: As indicated by manufacturer's designation, Match Architect's sample or as selected by Architect from full range of industry colors.
e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as indicated by manufacturer's designation, match Architect's sample or as selected by Architect from manufacturer's full range.
f. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint or acrylic polyurethane, in color as indicated by manufacturer's designation, matching Architect's sample or as selected by Architect from manufacturer's full range.
g. Photo-Image Graphics: Manufacturer's standard black-and-white, multicolor, 600-dpi halftone or dot-screen image.
h. Overcoat: Manufacturer's standard baked-on clear coating.

2.4 MATERIALS

A. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, Type 316, stretcher-leveled standard of flatness.

B. Acrylic Sheet: ASTM D4802, Type UVF (UV filtering).

C. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.

D. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal, stainless-steel or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design

load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing signs with imposed loads to structure.
2. Type: As directed Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Anchoring Materials:

1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

    a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
3. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

B. Post Fabrication: Fabricate posts designed for structural performance indicated and of lengths required for installation method indicated for each sign.

1. Aluminum Posts: Manufacturer's standard 0.125-inch- (3.18-mm-) thick, extruded-aluminum tubing unless otherwise indicated, with brackets or slots to engage sign panels.
2. Steel Posts: Fabricate from minimum 0.120-inch- (3.05-mm-) thick, steel tubing unless otherwise indicated.

    a. Hot-dip galvanize post assemblies after fabrication according to ASTM A123/A123M.

3. Direct Burial: Fabricate posts 36 inches (910 mm) longer than height of sign to permit direct burial or embedment in concrete foundations or concrete-filled postholes.
4. Baseplates: Fabricate posts with baseplates welded to bottom of posts. Drill holes in baseplate for anchor-bolt connection.

    a. As directed Provide preset or drilled-in-place anchor bolts of size required for connecting posts to concrete foundations.

5. Sleeves: Fabricate posts 12 inches (300 mm) longer than height of sign to permit embedment in sleeves cast in concrete foundations or concrete-filled postholes. Provide sleeves by manufacturer, sized to receive outside diameter of posts. As directed Size sleeves for direct embedment in concrete foundations or concrete-filled postholes and to prevent sign movement, but not less than 24 inches (610 mm) or 36 inches (910 mm) for embedment.
6. Reverse Sleeves: Provide inserts by sign manufacturer, sized for close fit inside posts. Size inserts for direct embedment in concrete foundations and to attach sign posts securely and prevent sign movement, but of a height not less than one-third of post height plus 36 inches (910 mm) for embedment.

    a. Provide through bolts to fasten posts to inserts.

C. Pylon Fabrication: Fabricate pylon signs with integral base consisting of channels, angles, plates, or other fittings. Design and fabricate pylon and anchorage for structural performance indicated. Detail anchorage so that water can drain out of assembly without obstruction. Drill holes in members for anchor-bolt connection. Provide anchor bolts of size required for connecting base to concrete foundations.

1. Internal Frames: Manufacturer's standard internal steel framing system and anchorage, modified as required for Project requirements. Provide welded construction. Cut, drill, and tap units to receive hardware, bolts, and similar items.

    a. Hot-dip galvanize steel framing system after fabrication according to ASTM A123/A123M.

2. External Frames: As directed Manufacturer's standard external aluminum or steel framing system and anchorage for direct attachment of sign message panels, modified as required for Project requirements. Provide welded construction using mitered joints. Cut, drill, and tap units to receive hardware, bolts, and similar items.

    a. Hot-dip galvanize steel framing system after fabrication according to ASTM A123/A123M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING POSTS

A. Direct-Burial Method:

1. Excavation: Excavate posthole to dimensions indicated. Reconstruct subgrade that is not firm, undisturbed, or compacted soil, or that is damaged by freezing temperatures, frost, rain, accumulated water, or construction activities by excavating an additional 12 inches (300 mm), backfilling with satisfactory soil or well-graded aggregate, and compacting to original subgrade elevation.
2. Setting in Earth: Set post in position, support to prevent movement, and backfill with satisfactory soil or well-graded aggregate as recommended in writing by manufacturer. Place and compact backfill in 6-inch (150-mm) lifts, compacting each lift.
3. Setting in Cast-in-Place Concrete: Set post in position, support to prevent movement, and place concrete in posthole or for concrete foundation as indicated on Drawings.
4. Setting in Preformed Hole in Concrete Foundation: Form or core drill holes in concrete foundation not less than 3/4 inch (20 mm) larger than outside dimension of post for installing posts in concrete. Set post in position, shim to prevent movement, and fill annular space between post and hole with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with manufacturer's written instructions.

    a. As directed Cover anchorage joint in concrete foundations with flange of same metal and finish as post, welded to post after placing anchoring material or attached to post with set screws.
    b. As directed Leave anchorage joint exposed with 1/8-inch (3-mm) anchoring material sloped away from post or anchoring material flush with adjacent surface.

B. Baseplate Method:

1. Preset Anchor Bolts: Set post baseplate in position over anchor bolts projecting from concrete foundation, shim and support post to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

2. Drilled-in-Place Anchor Bolts: Set post baseplate in position over concrete foundation, locate and drill anchor holes, shim and support post to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

C. Sleeve Method: Set post in position in sleeve and support post to prevent movement, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with manufacturer's written instructions.

1. As directed Cover anchorage joint with flange of same metal and finish as post, welded to post after placing anchoring material or attached to post with set screws.
2. As directed Leave anchorage joint exposed with 1/8-inch (3-mm) anchoring material sloped away from post or anchoring material flush with adjacent surface.

D. Reverse-Sleeve Method: Set post in position over the projecting insert and support post to prevent movement, drill posts and inserts for through bolts, and install and tighten through bolts.

3.3 INSTALLING PYLONS

A. Attachment with Preset Anchor Bolts: Set pylon base in position over anchor bolts projecting from concrete foundation, shim and support pylon to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

B. Attachment with Drilled-in-Place Anchor Bolts: Set pylon base in position over concrete foundation, locate and drill anchor holes, shim and support pylon to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

END OF SECTION 101426

SECTION 101429 - MODULAR SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular signage.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For modular signs.

1. Include plans, elevations, sections, and mounting details.
2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

D. Samples: For each type of modular sign, exposed component, and exposed finish.

E. Product Schedule: For modular signs. Use same designations indicated on Drawings or specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" or the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 MODULAR SIGNS

A. Modular Signs: Sign system with removable inserts for graphics and copy attached to a receiver frame system using clips, splines, or comparable method. Provide system with modular increments of height and width, permitting assembly of units with multiple inserts of varying size.

1. Sign Size: As indicated.

B. Inserts:

1. Module Height: System of inserts fabricated in multiples of manufacturer's standard dimension, 9/16 inch (15 mm), 1 inch (25 mm) or 1.25 inches (32 mm).
2. Type: As directed Extruded aluminum for applied graphics or Rigid plastic for applied graphics.
3. Finish: As directed Anodized, Painted or Plastic laminate.
4. Color and Pattern: As directed One or Two color(s), indicated by manufacturer's designation or selected by Architect from manufacturer's full range.

C. Graphics and Copy:

1. Surface Applied: As directed Die-cut vinyl film, Silk-screen, Direct print or Paint or Photo image.
2. Raised, ADA Compliant: Manufacturer's standard, Applied, Photopolymer or Subsurface raised characters and Braille.
3. Etched and Filled: Sign face etched or routed to receive enamel-paint infill.
4. Engraved: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
5. Text and Typeface: As directed Times Roman, Helvetica, Typeface as indicated by manufacturer's designation, Typeface matching Architect's sample or Typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

D. End Caps and Trim:

1. Side Trim: Continuous extruded-aluminum trim attached to message-strip receiver frame.
2. End Caps: As directed Individual snap-on caps for each message strip or Snap-on caps covering ends of multiple message strips.
3. Profile: As directed Narrow, Square, Bevel, Radius corner, Quarter round, Stepped or Contoured.
4. Top and Bottom Trim: As directed Message strips with integral trim profile to provide finished appearance or Extruded-aluminum trim section, attached to message-strip receiver frame. As directed Provide narrow face, square, bevel or contoured profile.

E. Mounting: Mount modular signs to wall surfaces using manufacturer's standard method, adhesive, two-faced tape or screws.

F. Accessories: Provide sliding insert to indicate room occupancy, user-changeable paper insert feature, note gripper or pen holder where indicated.

2.3 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

C. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form copy indicated on Drawings.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined. Use concealed fasteners and anchors unless indicated to be exposed.

B. Adhesive: As recommended by sign manufacturer.
   1. As directed.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

A. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.

B. Subsurface-Applied Graphics: Apply graphics to back of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Engraved Graphics: Reverse engrave back of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

D. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install signs using mounting methods indicated and in accordance with manufacturer's written instructions.

B. Accessible Signage: Install in locations on walls as indicated on Drawings and in accordance with the accessibility standards.

C. Adhesives and Tapes: Clean substrate to remove materials that would adversely affect bond. Use materials and quantities sufficient to support weight of sign after cure without slippage. Keep adhesives and tapes away from edges to prevent visibility at sign edges.

END OF SECTION 101429

SECTION 101473 - PAINTED SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field-lettered signs painted directly on substrates in good condition.
2. Wall-identification signs for fire and smoke assemblies.

B. Related Requirements:

1. Section 321723 "Pavement Markings" for signage painted on pavements.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For painted signs.

1. Show sign locations and mounting heights.

2. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

D. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Color Matching Certificate: For computer color matching of colors.

1.6 QUALITY ASSURANCE

A. Color Matching: Custom computer-match paint colors to colors indicated as directed. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer-match paint colors to the color chips.

PART 2 - PRODUCTS

2.1 SIGN-PAINT MANUFACTURERS

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions as directed.

2.3 PAINTED SIGNS

A. Painted Sign: Sign painted directly on indicated substrate, including primers, sealers, undercoats, and transition coats as required.

1. Paint Type: As directed.

    a. Gloss: As directed.

2. Substrate: As directed.
3. Text and Typeface: As directed.

    a. Size: 2 in. (51 mm) based on height of uppercase "I" letter.
    b. Color: As directed.

4. Background: Characters outlined or Overall rectangular background or as directed.

    a. Thickness or Extent: As directed.
    b. Color: As directed.

B. Wall-Identification Sign: Sign applied directly on indicated substrate to identify fire and smoke assemblies, including preparatory treatment as required.

1. Sign Material: Stenciled-on as directed on paint or preprinted, self-adhesive decals.
2. Font: Minimum 3 inches (76 mm) high characters in a contrasting color, with minimum 0.375-inch (9.5-mm) wide strokes.
3. Text: As directed.

2.4 PAINT MATERIALS

A. Sign Paints and Coatings: Inks, dyes, and paints that are recommended in writing by manufacturer for optimum adherence to substrate and are UV and water resistant for colors and exposure indicated.

1. Compatibility: Provide paint materials that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Proceed with installation only after unsatisfactory conditions have been corrected and surface is dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

B. Apply a transition coat over incompatible existing coatings and substrate materials.

C. Apply primers, sealers, undercoats, and transition coats so that they do not extend beyond the limits of the painted signage. Remove excess without damaging the substrate.

D. Install signs level, plumb, true to line, with uniform delineation and borders, and at locations and heights indicated.

E. Signs Painted on Glass: Provide opaque, black paint matching painted sign material and finish onto opposite side of glass to conceal back of sign.

3.2 MARKING FIRE AND SMOKE ASSEMBLIES

A. Wall-Identification Signs: Permanently identify both sides of each fire and smoke assembly indicated on Drawings. Place signs in accessible, concealed floor, floor-ceiling, or attic space at maximum 15 feet (4.57 m) from end of wall and at maximum intervals of 30 feet (9.14 m), measured horizontally along the assembly. Locate signs for greatest visibility in the space.

END OF SECTION 101473

SECTION 101700 - TELEPHONE SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall-mounted telephone enclosures.
2. Pedestal-mounted telephone enclosures.
3. Wall-mounted telephone housings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each telephone specialty.

1. Include plans, elevations, sections, and mounting details.
2. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: As directed Comply with applicable provisions in the USDJ's "2010 ADA Standards for Accessible Design" or the ABA standards of the Federal agency having jurisdiction and ICC A117.1 for telephone specialties.

2.2 WALL-MOUNTED TELEPHONE ENCLOSURES

A. Wall-Mounted Telephone Enclosure: Individual enclosure or In-line group of multiple enclosures as indicated on Drawings, constructed for indoor exposure.

1. Construction: Surface-mounted, one-piece, shell-configuration enclosure, curved in plan to form rear and side walls; with acoustical-panel interior surface, concealed internal reinforcement, and writing shelf.

    a. Material: As directed Stainless steel or Aluminum.
    b. Stainless-Steel Finish: No. 4.
    c. Aluminum Finish: As directed Clear anodic finish or Color anodic finish, dark bronze.

2. Construction: Recessed enclosure consisting of acoustical-panel rear and side walls, soffit, and writing shelf.

    a. Material: As directed Stainless steel or Aluminum.
    b. Stainless-Steel Finish: No. 4.
    c. Aluminum Finish: As directed Clear anodic finish or Color anodic finish, dark bronze.

3. Construction: Surface-mounted enclosure consisting of flat rear wall, straight side walls, and writing shelf.

    a. Rear Wall: As directed Stainless-steel acoustical panel, Aluminum acoustical panel, Stainless steel, Aluminum or 3/16-inch (4.76-mm) polyethylene.
    b. Side Walls: As directed Double-wall, stainless-steel acoustical panels, Double-wall, aluminum acoustical panels, Plastic-laminate panels, 3/16-inch (4.76-mm) polyethylene, Frameless, 12-mm-thick tempered glass, Frameless, 0.47-inch- (12-mm-) thick acrylic sheet or Extruded-aluminum frame, glazed with 6-mm-thick tempered glass.
    c. Stainless-Steel Finish: No. 4.
    d. Aluminum Finish: Clear anodic finish or Color anodic finish, dark bronze.
    e. Plastic-Laminate Finish: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.
    f. Tempered Glass: As directed Clear or Tinted.
    g. Acrylic Sheet: As directed Clear or Tinted.

4. Telephone Mounting: As directed Provide steel or stainless-steel mounting plate with threaded inserts located to receive surface-mounted telephone; plate is concealed when telephone is installed.
5. Telephone Mounting: Provide for flush-mounted telephone, recessed into built-in mounting adapter, with hinged door and locking provisions to simulate panel-style telephone.
6. Telephone Adaptor: Provide adaptor if required for installation of telephone.
7. Shelf: As directed Full-width stainless-steel, aluminum or 12-mm-thick, clear tempered-glass writing shelf.

a. Directory Storage: As directed Undershelf directory shelf with directory binder and chain, Shelf-mounted, swing-out directory holder with directory binder or Wall-mounted, swing-out directory holder with directory binder.

8. Header Panel: As directed Integral header panel with telephone sign, telephone sign and concealed fluorescent lighting with acrylic diffuser or illuminated telephone sign and concealed fluorescent lighting with acrylic diffuser, and matching metal material and finish of rear wall or side walls.
9. Accessories: As directed Provide electrical outlet and shelf sized for TTY or electrical outlet and undershelf bracket for TTY for each telephone indicated on Drawings.

2.3 PEDESTAL-MOUNTED TELEPHONE ENCLOSURES

A. Pedestal-Mounted Telephone Enclosure: As directed Individual enclosure, Two-position, back-to-back pair of enclosures, Two-position, angled, side-by-side pair of enclosures, Four-position carousel group of enclosures, Six-position carousel group of enclosures or Six-position in-line group of enclosures, constructed for outdoor or indoor exposure.

1. Construction: One-piece, shell-configuration enclosure, curved in plan to form rear and side walls; with acoustical-panel interior surface, concealed internal reinforcement, and writing shelf.

    a. Material: As directed Stainless steel or Aluminum.
    b. Stainless-Steel Finish: No. 4.
    c. Aluminum Finish: As directed Clear anodic finish or Color anodic finish, dark bronze.

2. Construction: Enclosure consisting of flat rear wall, straight side walls, and writing shelf.

    a. Rear Wall: As directed Stainless-steel acoustical panel, Aluminum acoustical panel, Stainless steel, Aluminum or 3/16-inch (4.76-mm) polyethylene.
    b. Side Walls: As directed Double-wall, stainless-steel acoustical panels, Double-wall, aluminum acoustical panels, Frameless, 12-mm-thick tempered glass, Frameless, 0.47-inch- (12-mm-) thick acrylic sheet, Extruded-aluminum frame, glazed with 6-mm-thick tempered glass or 3/16-inch (4.76-mm) polyethylene.
    c. Stainless-Steel Finish: No. 4.
    d. Aluminum Finish: Clear anodic finish or Color anodic finish, dark bronze.
    e. Tempered Glass: As directed Clear or Tinted.
    f. Acrylic Sheet: As directed Clear or Tinted.

3. Pedestal: As directed Steel or Aluminum pedestal for floor mounting with concealed mounting bolts. Include matching metal covers with tamper-resistant fasteners for access to service components.

    a. Service Entry: Through pedestal base.
    b. As directed Steel or Aluminum Finish: Baked enamel or powder coat.
    c. Color: As directed Black, Match Architect's sample or as selected by Architect from manufacturer's full range.

4. Telephone Mounting: Provide steel or stainless-steel mounting plate with threaded inserts located to receive surface-mounted telephone; plate is concealed when telephone is installed.
5. Telephone Mounting: Provide for flush-mounted telephone, recessed into built-in mounting adapter, with hinged door and locking provisions to simulate panel-style telephone.
6. Telephone Adaptor: Provide adaptor if required for installation of telephone.
7. Shelf: Full-width stainless-steel, aluminum or 12-mm-thick, clear tempered-glass writing shelf.

    a. Directory Storage: As directed Undershelf directory shelf with directory binder and chain or Shelf-mounted, swing-out directory holder with directory binder.

8. Header Panel: As directed Integral header panel with telephone sign, telephone sign and concealed fluorescent lighting with acrylic diffuser or illuminated telephone sign and concealed fluorescent lighting with acrylic diffuser, and matching metal material and finish of rear wall or side walls.
9. Roof and Ceiling Assembly: Combination roof and ceiling assembly consisting of one-piece flat roof and hinged, translucent-plastic ceiling panel.

    a. Lighting: Circular, 40-W fluorescent lamp above ceiling activated by photoelectric device.
    b. Signs: One illuminated sign face for each exposed direction of each telephone enclosure. Mount signs in fascia.
    c. Sign Text: As directed.

10. Accessories: As directed Provide electrical outlet and shelf sized for TTY or electrical outlet and undershelf bracket for TTY for each telephone indicated on Drawings.

2.4 WALL-MOUNTED TELEPHONE HOUSINGS

A. Wall-Mounted Telephone Housing: As directed Fully recessed, Semirecessed or Surface-mounted telephone-set housing, as indicated on Drawings, constructed for indoor exposure.
    1. Construction: Flush, stainless steel with steel mounting frame.

        a. Stainless-Steel Finish: No. 4.

    2. Telephone Mounting: Provide for flush-mounted telephone, recessed into built-in mounting adapter, with hinged door and locking provisions to simulate panel-style telephone.
    3. Shelf: Full-width writing shelf in metal and finish matching general construction.
    4. Directory Storage: As directed Fully recessed or Semirecessed directory shelf with directory binder and chain.
    5. Accessories: Provide electrical outlet and shelf sized for TTY for each telephone indicated on Drawings.

2.5 MATERIALS

A. Acoustical Panel: Perforated metal panel with not less than 1000 perforations/sq. ft. (10 000 perforations/sq. m) and with enclosed, nonflaking or wrapped, glass-fiber sound-absorption blanket or board. Where double-wall panel is indicated, provide perforated metal sheet at interior of enclosure and unperforated metal sheet at exterior.

B. Plastic-Laminate Panels: NEMA LD 3, laminated to 1/2-inch- (13-mm-) thick particleboard.

C. Particleboard: Panels complying with ANSI A208.1, Grade M-2.

1. Made with binder containing no urea formaldehyde.
2. Fire-retardant panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84 or UL 723.

D. Tempered Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I (transparent glass, flat), clear or tinted as indicated.

E. Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast) or Category A-2 (continuous cast), Finish 1 (smooth or polished), clear or tinted as indicated.

F. Fasteners: Screws, bolts, inserts, anchorages, and other fastening devices of same material as items being fastened, and of same finish where exposed, except provide stainless-steel fasteners for exterior exposures. Use tamperproof fasteners where exposed to view.

2.6 STAINLESS-STEEL FINISHES

A. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install telephone specialties according to manufacturer's written instructions. Install units level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.

B. Install telephone specialties after other finishing operations, including painting, have been completed.

END OF SECTION 101700

SECTION 102113.13 - METAL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes painted steel toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PAINTED STEEL TOILET COMPARTMENTS

A. Toilet-Enclosure Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

B. Entrance-Screen Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

C. Urinal-Screen Style: As directed Wall hung, flat panel, Wall hung with integral flanges, Wall hung, wedge shaped, Floor anchored, Overhead braced or Post to ceiling.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf (1112 N), when tested according to ASTM F446, without deformation of panel.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.
2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.
3. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum 6 inches (152 mm) wide at wall and minimum 1 inch (25 mm) wide at protruding end.

F. Facing Sheets and Closures: Electrolytically coated steel or hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.036 inch (0.91 mm).
2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.048 inch (1.21 mm).
3. Panels: As directed Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm) or 0.036 inch (0.91 mm).
4. Doors: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm).
5. Flat-Panel Urinal Screens: Thickness matching the panels.
6. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm).
7. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.036 inch (0.91 mm).

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

H. Urinal-Screen Post: As directed Manufacturer's standard post design of material matching the thickness and construction of pilasters or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):

1. Stirrup Type: As directed Ear or U-brackets; chrome-plated zamac, clear-anodized aluminum, stainless steel or chrome-plated brass.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel or aluminum.

J. Steel Sheet Finish: Manufacturer's standard baked-on finish.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

a. As directed Allow for application of one color or two colors in each room.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: As directed Chrome-plated zamac, Clear-anodized aluminum or Chrome-plated brass.
2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: As directed Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open

approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.13

SECTION 102113.14 - STAINLESS-STEEL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stainless-steel toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 STAINLESS-STEEL TOILET COMPARTMENTS

A. Toilet-Enclosure Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

B. Entrance-Screen Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

C. Urinal-Screen Style: As directed Wall hung flat panel, Wall hung with integral flanges, Wall hung, wedge shaped, Floor anchored, Overhead braced or Post to ceiling.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf (1112 N), when tested according to ASTM F446, without deformation of panel.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.
2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.
3. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum 6 inches (152 mm) wide at wall and minimum 1 inch (25 mm) wide at protruding end.

F. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch (0.95 mm).
2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch (1.27 mm).
3. Panels: As directed Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm) or 0.038 inch (0.95 mm).
4. Doors: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
5. Flat-Panel Urinal Screens: Thickness matching the panels.
6. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
7. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.038 inch (0.95 mm).

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

H. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):

1. Stirrup Type: As directed Ear or U-brackets; chrome-plated zamac, clear-anodized aluminum, stainless steel or chrome-plated brass.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel or aluminum.

J. Stainless-Steel Finish: As directed No. 4 bright, directional polish or Manufacturer's standard textured finish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel anchors compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished

ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: As directed Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.14

SECTION 102113.16 - PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic-laminate-clad toilet compartments configured as directed.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: As directed.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 as directed for toilet compartments designated as accessible.

2.2 PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

A. Toilet-Enclosure Style: As directed.

B. Entrance-Screen Style: As directed.

C. Urinal-Screen Style: As directed.

D. Door, Panel, Screen, and Pilaster Construction: One-piece, plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with laminate applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture. Provide with no-sightline system.

1. Core Material: Particleboard.
2. Doors and Panels: Finished to not less than 7/8 inch (22 mm) or 1 inch (25 mm) thick as directed.
3. Pilasters: Provide construction to comply with one of the following:

    a. Finished to not less than 1-1/4 inches (32 mm) thick and with internal, nominal 0.134-inch- (3.42-mm-) thick, steel-sheet reinforcement.
    b. Finished to 1-1/4 inches (32 mm) thick and with manufacturer's standard steel-sheet core laminated to both sides of honeycomb of resin-impregnated kraft paper in lieu of particleboard core.
    c. Finished to not less than 1 inch (25 mm) thick and with internal, nominal 0.120-inch- (3.04-mm-) thick, steel-sheet reinforcement.

E. Pilaster Shoes and Sleeves (Caps) as directed: Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

F. Urinal-Screen Post: As directed.

G. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, as directed.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel or aluminum as directed.

H. Plastic-Laminate Finish: One color and pattern or Two colors and patterns as directed in each room.

1. Color and Pattern: As directed.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel anchors compatible with related materials.

2.4 MATERIALS

A. Particleboard: ANSI A208.1, Grade M-2.

B. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and as directed near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.16

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: As directed 25, 75 or 200 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Toilet-Enclosure Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

B. Entrance-Screen Style: As directed Overhead braced, Floor anchored, Ceiling hung or Floor and ceiling anchored.

C. Urinal-Screen Style: As directed Wall hung, Floor anchored, Overhead braced or Post to ceiling.

D. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

E. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

F. Urinal-Screen Post: As directed Manufacturer's standard post design of monolithic phenolic urinal screen cut out at bottom to form a post, material matching the thickness and construction of pilasters or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster.

G. Brackets (Fittings):

1. Stirrup Type: As directed Ear or U-brackets, chrome-plated zamac, clear-anodized aluminum, stainless steel or chrome-plated brass.
2. Full-Height (Continuous) Type: As directed Manufacturer's standard design; stainless steel or aluminum.

H. Phenolic-Panel Finish:

1. Facing Sheet Finish: As directed One color and pattern or Two colors and patterns in each room.
2. Color and Pattern: As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range, with manufacturer's standard dark color core or through-color core matching face sheet.
3. Edge Color: As directed Manufacturer's standard or Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: As directed Chrome-plated zamac, Clear-anodized aluminum, Stainless steel or Chrome-plated brass.
2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid-plastic toilet compartments configured as directed.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

D. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: As directed.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 as directed for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Toilet-Enclosure Style: As directed.

B. Entrance-Screen Style: As directed.

C. Urinal-Screen Style: As directed.

D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel as directed strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern or Two colors and patterns as directed in each room as indicated by manufacturer's designations or as selected by Architect from manufacturer's full range as directed.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.

1. Polymer Color and Pattern: As directed.

F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters or 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster as directed.

G. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets or as directed.
2. Full-Height (Continuous) Type: Manufacturer's standard design; as directed.

    a. Polymer Color and Pattern: As directed.

H. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: As directed.
2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

B. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel as directed.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102113.40 - STONE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stone toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone and each type of stone accessory, door, hardware, bracket (fitting), and other manufactured product.

B. Sustainable Design Submittals:
   1. As directed.

C. Shop Drawings: For stone toilet compartments. Include plans, elevations, sections, details, and attachments to other work in one coordinated submittal together with product data.

D. Samples for each exposed product and for each color and texture specified.

   1. Stone: Sets for each color, grade, finish, and variety of stone required.
   2. Doors: Door faces and edges finished with materials proposed for the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Qualification Data: As directed For qualified Installer or fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop accredited by MIA that employs skilled workers who custom-fabricate stone toilet compartments similar to those indicated for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: As directed Fabricator of products, an experienced installer, accredited by MIA or who has completed stone toilet compartment installations similar in material, design, and extent to those indicated for this Project and whose installations have a record of successful in-service performance.

C. Source Limitations for Stone: Obtain each variety of stone from single quarry with resources to provide materials of consistent quality in appearance and physical properties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities" and ICC A117.1 for toilet compartments designated as accessible.

2.2 STONE TYPES

A. Marble: ASTM C503/C503M, Soundness Group A; selected for uniform visual quality.

1. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

2. Cut: As directed Vein or Fleuri.
3. Finish: As directed Polished, Honed or Match Architect's sample.

B. Granite: ASTM C615 and complying with NBGQA's "Specifications for Architectural Granite"; free of cracks, defects, and geological flaws; and selected for uniform visual quality.

1. Varieties and Sources: Subject to compliance with requirements, provide the following, provide one of the following or available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

2. Cut: As directed Vein or Fleuri.
3. Finish: Polished, Honed or Match Architect's sample.

C. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ICPA SS-1.
1. Colors and Patterns: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

D. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 OTHER MATERIALS

A. Brass Castings: ASTM B584.

B. Stainless-Steel Sheet: ASTM A666, Type 304, stretcher-leveled standard of flatness.

C. Stainless-Steel Castings: ASTM A743/A743M.

D. Particleboard: ANSI A208.1, Grade M-2.

E. Plastic Laminate: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

2.4 STONE TOILET COMPARTMENTS

A. Toilet-Enclosure Style: As directed Floor anchored, Ceiling hung or Floor and ceiling anchored.

B. Entrance-Screen Style: As directed Floor anchored, Ceiling hung or Floor and ceiling anchored.

C. Urinal-Screen Style: As directed Floor anchored, Ceiling hung or Floor and ceiling anchored.

D. Stone Type: As directed

E. Stone Veining: Cut stone so that, when installed, veining will be approximately vertical.

F. Doors: As directed Plastic laminate, Stainless steel or Wood.

G. Hardware and Bracket (Fitting) Material and Finish: As directed Fabricator's standard chrome-plated brass, stainless steel or polished brass.

2.5 DOORS AND HARDWARE

A. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

B. Plastic-Laminate Doors: One-piece plastic-laminate facing sheets pressure laminated to core material without splices or joints in facings or cores; with laminate applied to edges before faces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture.

1. Core Material: Particleboard.
2. Finished Door Thickness: Not less than 1 inch (25 mm).
3. Plastic-Laminate Color and Pattern: As selected by Architect from manufacturer's full range.

C. Stainless-Steel Doors: Seamless, stainless-steel facing sheets pressure laminated to core material; with continuous, interlocking stainless-steel molding strip or lapped and formed edge closures; corners secured by welding or clips, and exposed welds are ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Thickness of Facing Sheets: Manufacturer's standard, but not less than 0.031 inch (0.79 mm).

2. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required for finished door thickness.
3. Finished Door Thickness: Not less than 1 inch (25 mm).
4. Stainless-Steel Finish: As directed No. 4 bright, directional polish or Manufacturer's standard textured finish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

D. Wood Doors: As specified in Section 081416 "Flush Wood Doors" or Section 081433 "Stile and Rail Wood Doors."

E. Wood Doors: As directed Red-oak- or Birch- veneered, solid-core flush doors, 1 inch (25 mm) thick; with particleboard core and hardwood edge bands bonded on all four edges; finished with transparent or opaque finish as selected by Architect from manufacturer's full range of colors and gloss or matching Architect's sample.

F. Hardware: Manufacturer's standard design, heavy-duty operating hardware and accessories, coordinated with actual thicknesses of stone and door and complying with the following:

1. Cutout-Inset-Type Hinges: Manufacturer's standard design, heavy-duty, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees. Provide hinges that wrap around stone stiles for through-bolt attachment.
2. Surface-Mounted Hinges: Manufacturer's standard design, heavy-duty, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
3. Latch and Keeper: As directed Manufacturer's standard design, heavy-duty recessed or surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors and entrance-screen doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

2.6 ACCESSORIES

A. Dowels: Stainless-steel dowels, 1/4-inch (6-mm) diameter, ASTM A276, Type 304.

B. Brackets (Fittings): Fabricator's standard design, heavy-duty cast-brass or cast-stainless-steel, angle-type brackets (fittings), with 1-3/4-by-1-3/4-inch (44-by-44-mm) legs, 1-1/4 inches (32 mm) long, coordinated with actual thickness of stone, and capable of supporting stone units in configuration indicated.

C. Stile Reinforcement: Continuous 1/4-by-3/4-inch (6-by-19-mm) extruded-aluminum spline complying with ASTM B221 (ASTM B221M) in alloy and temper recommended by fabricator for use indicated.

D. Anchorages and Fasteners: Fabricator's standard design, heavy-duty exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type through-bolts with lengths coordinated with actual thickness of stone or other material they are securing. For concealed anchors, use stainless steel or hot-dip galvanized steel.

2.7 FABRICATION

A. General: Fabricate stone to sizes and shapes indicated on Drawings.

1. For marble, comply with recommendations in MIA's "Dimension Stone Design Manual."
2. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Cut stone from contiguous, matched slabs in which natural markings occur. Select and mark stone for final locations to produce assembled toilet compartments with an overall uniform appearance.

C. Provide even (gaged) thicknesses indicated, but not less than the following:

1. Panel and Screen Thickness: As directed 30 or 20 mm.
2. Stile Thickness: 30 mm.

D. Cut stone with a surface tolerance of not more than plus or minimum 0.8 mm from true plane.

E. Finish exposed faces and edges of stone to match approved Samples. Provide stone with eased, exposed edges.

F. Ceiling-Hung Units: Reinforce each stile with a continuous aluminum spline recessed flush in groove cut into the stone and located where panel abuts the stile so as to be concealed within the joint. Use adhesive and mechanical fasteners to attach spline to stone.

G. Ceiling Anchorage: Provide corrosion-resistant anchoring assemblies complete with leveling adjustment nuts to connect stiles to structural support above finished ceiling. Provide assemblies that support stiles from structure without transmitting load to finished ceiling. Locate anchorage to be entirely concealed by the ceiling.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with fabricator's written installation instructions. Install units rigid, straight, level, and plumb.

B. Install anchors, fasteners, and other attachments indicated or necessary to secure stone in place. Shim and adjust anchors and supports to set stone accurately in locations indicated, with uniform joints of widths indicated and with edges and faces aligned.

C. Secure stone panels to walls and stiles with no fewer than three pairs of angle brackets (fittings), installed back to back. Use through-bolt fasteners to attach angle brackets (fittings) to stone. At wall connections, provide fasteners suitable for supporting construction.

D. Do not allow stone to come in contact with plumbing sealant or putty.

E. Floor-Anchored Units: Anchor units to floor rigid, level, and plumb.

1. Hang doors and adjust so tops of doors are level with tops of stiles when doors are in closed position.
2. Floor Anchorage: Set units onto finished floor as indicated, supported on structural floor. Secure each unit with no fewer than two dowels epoxied into unit and structural floor. Provide minimum 1-inch (25-mm) dowel penetration of structural floor.

F. Ceiling-Hung Units: Secure stiles to supporting structure with anchoring assembly, to connect stiles to structural support above finished ceiling as indicated, rigid, level, and plumb. Hang doors and adjust so bottoms of doors are level with bottoms of stiles when doors are in closed position.

G. Floor-and-Ceiling-Anchored Units: Anchor units to floor rigid, level, and plumb; secure tops of stiles to supporting structure with anchoring assembly as indicated.

1. Hang doors and adjust so tops of doors are level with each other when doors are in closed position and level with tops of partitions unless otherwise indicated.
2. Floor Anchorage: Set units onto finished floor as indicated, supported on structural floor. Secure each unit with no fewer than two dowels epoxied into unit and structural floor. Provide minimum 1-inch (25-mm) dowel penetration of structural floor.

H. Prepare joints and apply sealants, at locations indicated, to comply with applicable requirements in Section 079200 "Joint Sealants."

3.2 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

B. Clean stone toilet compartments no fewer than six days after completion of sealant installation or installation As directed, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone; follow methods recommended by MIA.

END OF SECTION 102113.40

SECTION 102116.13 - METAL SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Painted-steel compartments.
2. Shower receptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For shower and dressing compartments.

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 as directed for shower and dressing compartments designated as accessible.

2.2 PAINTED-STEEL COMPARTMENTS

A. Configuration: As directed.

B. Enclosure Style: Overhead braced or Floor and ceiling anchored as directed.

C. Panel and Pilaster Construction: Seamless steel facing sheets, pressure laminated to core material, with continuous, interlocking molding strip or lapped-and-formed edge closures and with corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard, sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for panels and 1-1/4 inches (32 mm) for pilasters.
2. Grab-Bar and Seat Reinforcement: Concealed internal reinforcement of size and material adequate for panel to withstand required grab-bar or seat loading without deformation of panel.
3. Tapping Reinforcement: Concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to compartments.

D. Door Construction: Match panels; 1-inch (25-mm) finished thickness.

E. Facing Sheets and Edge Closures: Hot-dip galvanized-steel sheet in manufacturer's standard, nominal base-metal (uncoated) thicknesses.

F. Pilaster Shoes and Sleeves (Caps) as directed: Formed from stainless steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
2. Stirrup Type: Ear or U-brackets; as directed.
3. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Section 102113.13 "Metal Toilet Compartments."

H. Steel-Sheet Finish: Manufacturer's standard baked-on finish with one color or two colors as directed in each room.

1. Color: As directed.

2.3 SHOWER RECEPTORS

A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.

1. Provide each unit with a ramped entrance surface for accessible compartments.
2. Drain Strainer: Manufacturer's standard; removable.
3. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.

B. Finish: Manufacturer's standard finish on exposed surfaces, as directed and with slip-resistant floor surface texture.

2.4 MATERIALS

A. Steel Sheet: ASTM A653/A653M, either hot-dip galvanized or galvannealed; mill phosphatized and selected for smoothness.

2.5 ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.

1. Material: As directed.
2. Hinges: Manufacturer's standard, as directed, allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard, recessed or surface-mounted as directed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not or at compartments designated as accessible as directed.
4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at inswinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at outswinging doors.
6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with antigrip profile; in manufacturer's standard finish.

C. Headrail with Hooks: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.

D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- (25-mm-) diameter, stainless steel curtain rod with matching hooks.

E. Curtain: Flame-resistant, polyester-reinforced vinyl fabric or manufacturer's standard fabric that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than 90 deg F (32 deg C).

1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch (13 mm).
4. Color and Pattern: As directed.

F. Soap Holder: Surface-mounted or Recessed as directed, seamless stainless steel soap dish.

G. Seats: Manufacturer's standard benches.

1. Material: As directed.
2. Operation: Fixed or Folding as directed.
3. Finish: As directed.

H. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

2.6 FABRICATION

A. Overhead-Braced Compartments: Manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.

B. Floor-and-Ceiling-Anchored Compartments: Manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

C. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard shower and dressing compartments, and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.

1. Clearances for Dressing Compartments: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.
2. Stirrup Brackets for Dressing Compartments: Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel as directed.

    a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets for Dressing Compartments: Secure panels to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Curtains: Install curtains to specified length, verify that they hang vertically without stress points or diagonal folds.

C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.

B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116.13

SECTION 102116.14 - STAINLESS-STEEL SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel compartments.
2. Shower receptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For shower and dressing compartments.

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for shower and dressing compartments designated as accessible.

2.2 STAINLESS-STEEL COMPARTMENTS

A. Configuration: As directed Shower compartment, Shower and dressing compartments, Shower compartment with two dressing compartments or As indicated on Drawings.

B. Enclosure Style: As directed Overhead braced or Floor and ceiling anchored.

C. Panel and Pilaster Construction: Seamless stainless-steel facing sheets, pressure laminated to core material, with continuous, interlocking molding strip or lapped-and-formed edge closures and with corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard, sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for panels and 1-1/4 inches (32 mm) for pilasters.
2. Grab-Bar and Seat Reinforcement: Concealed internal reinforcement of size and material adequate for panel to withstand required grab-bar or seat loading without deformation of panel.
3. Tapping Reinforcement: Concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to compartments.

D. Door Construction: Match panels; 1-inch (25-mm) finished thickness.

E. Facing Sheets and Edge Closures: Stainless-steel sheet in manufacturer's standard, nominal thicknesses.

F. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
2. Stirrup Type: Ear or U-brackets; As directed clear-anodized aluminum, stainless steel or chrome-plated brass.
3. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Section 102113.14 "Stainless-Steel Toilet Compartments."

H. Stainless-Steel Finish: As directed No. 4, bright, directional polish, Manufacturer's standard textured finish as selected, Manufacturer's standard vertically striped finish or Match toilet-compartment finish, specified in Section 102113.14 "Stainless-Steel Toilet Compartments," on exposed faces. Protect exposed surfaces from damage by applying strippable, temporary protective covering before shipment.

2.3 SHOWER RECEPTORS

A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.

1. Provide each unit with a ramped entrance surface for accessible compartments.
2. Drain Strainer: Manufacturer's standard; removable.
3. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.

B. Finish: Manufacturer's standard finish on exposed surfaces, matching color of enclosure panels, as indicated by manufacturer's designations or as selected by Architect from manufacturer's full range and with slip-resistant floor surface texture.

2.4 ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.

1. Material: As directed Clear-anodized aluminum, Stainless steel or Chrome-plated brass.
2. Hinges: Manufacturer's standard, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, continuous, cam type that swings to a closed or partially open position or continuous, spring-loaded type, allowing emergency access by lifting door.
3. Latch and Keeper: As directed Manufacturer's standard, recessed or surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. As directed Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not or at compartments designated as accessible.
4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at inswinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at outswinging doors.
6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with antigrip profile; in manufacturer's standard finish.

C. Headrail with Hooks: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.

D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- (25-mm-) diameter, stainless-steel curtain rod with matching hooks.

E. Curtain: As directed Flame-resistant, polyester-reinforced vinyl fabric or manufacturer's standard fabric that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than 90 deg F (32 deg C).

1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch (13 mm).
4. Color and Pattern: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

F. Soap Holder: As directed Surface-mounted or Recessed, seamless stainless-steel soap dish.

G. Seats: As directed Manufacturer's standard, panel-mounted, wall-mounted or floor-mounted benches.

1. Material: As directed Wood, Solid phenolic, Molded plastic or Stainless steel.
2. Operation: As directed Fixed or Folding.
3. Finish: As directed, as indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from manufacturer's full range or Match enclosure panels.

H. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

2.5 FABRICATION

A. Overhead-Braced Compartments: Manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.

B. Floor-and-Ceiling-Anchored Compartments: Manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

C. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard shower and dressing compartments, and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.

1. Clearances for Dressing Compartments: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.
2. Stirrup Brackets for Dressing Compartments: As directed Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel.

    a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets for Dressing Compartments: Secure panels to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Curtains: Install curtains to specified length, verify that they hang vertically without stress points or diagonal folds.

C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.

B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116.14

SECTION 102116.17 - PHENOLIC-CORE SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid, phenolic-core compartments.
2. Shower receptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For shower and dressing compartments.

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: As directed.
2. Smoke-Developed Index: 450 or less.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings

and Facilities and ICC A117.1 for shower and dressing compartments designated as accessible as directed.

2.2 PHENOLIC-CORE COMPARTMENTS

A. Configuration: As directed.

B. Enclosure Style: Overhead braced or Floor and ceiling anchored as directed.

C. Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused together during panel manufacture (not separately laminated) and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick pilasters and minimum 1/2-inch- (13-mm-) thick panels.

D. Door Construction: Match panels; 3/4-inch (19-mm) minimum thickness.

E. Pilaster Shoes and Sleeves (Caps): Formed from stainless steel sheet, not less than 3 inches (76 mm) high, finished to match hardware.

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; clear-anodized aluminum.
2. Stirrup Type: Ear or U-brackets; as directed
3. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Section 102113.17 "Phenolic-Core Toilet Compartments."

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern or Two colors and patterns in each room as directed.
2. Color and Pattern: As directed with manufacturer's standard dark-color core or through-color core matching face sheet.

2.3 SHOWER RECEPTORS

A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.

1. Provide each unit with a ramped entrance surface for accessible compartments.
2. Drain Strainer: Manufacturer's standard; removable.
3. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.

B. Finish: Manufacturer's standard finish on exposed surfaces, as directed and with slip-resistant floor surface texture.

2.4 ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories.

1. Material: As directed.
2. Hinges: Manufacturer's standard, as directed, allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard, recessed or surface-mounted as directed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not or at compartments designated as accessible as directed.
4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at inswinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at outswinging doors.
6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with antigrip profile; in manufacturer's standard finish.

C. Headrail with Hooks: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.

D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- (25-mm-) diameter, stainless steel curtain rod with matching hooks.

E. Curtain: Flame-resistant, polyester-reinforced vinyl fabric or manufacturer's standard fabric as directed that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than 90 deg F (32 deg C).

1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch (13 mm).
4. Color and Pattern: As directed.

F. Soap Holder: Surface-mounted or Recessed as directed, seamless stainless steel soap dish.

G. Seats: Manufacturer's standard benches as directed.

1. Material: As directed.
2. Operation: Fixed or Folding as directed.
3. Finish: As directed.

H. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

2.5 FABRICATION

A. Overhead-Braced Compartments: Manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.

B. Floor-and-Ceiling-Anchored Compartments: Manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

C. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard shower and dressing compartments, and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.

1. Clearances for Dressing Compartments: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.
2. Stirrup Brackets for Dressing Compartments: Secure panels to walls and to pilasters with no fewer than two brackets attached or three brackets attached at midpoint and near top and bottom of panel as directed.

    a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets for Dressing Compartments: Secure panels to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Curtains: Install curtains to specified length, and verify that they hang vertically without stress points or diagonal folds.

C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease-

and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.

B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116.17

SECTION 102116.19 - PLASTIC SHOWER AND DRESSING COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic compartments.
2. Shower receptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For shower and dressing compartments.

1. Include plans, elevations, sections, and attachment details.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: As directed 25, 75 or 200 or less.
2. Smoke-Developed Index: 450 or less.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for shower and dressing compartments designated as accessible.

2.2 SOLID-PLASTIC COMPARTMENTS

A. Configuration: Shower compartment, Shower and dressing compartments, Shower compartment with two dressing compartments or As indicated on Drawings.

B. Enclosure Style: As directed Overhead braced or Floor and ceiling anchored.

C. Panel and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard, continuous, clear-anodized extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: As directed One color and pattern or Two colors and patterns in each room; as indicated by manufacturer's designations, as selected by Architect from manufacturer's full range or match toilet compartments specified in Section 102113.19 "Plastic Toilet Compartments".

D. Door Construction: Match panels.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; solid plastic or stainless steel.

1. Plastic Color and Pattern: As directed Match pilaster, Contrast with pilaster, as indicated by manufacturer's designations, Contrast with pilaster, as selected by Architect from manufacturer's full range or Match toilet compartments specified in Section 102113.19 "Plastic Toilet Compartments".

F. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; solid plastic matching the panels or clear-anodized extruded aluminum, solid plastic matching the panels or clear-anodized extruded aluminum.
2. Stirrup Type: Ear or U-brackets; As directed clear-anodized aluminum, stainless steel or chrome-plated brass.
3. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Section 102113.19 "Plastic Toilet Compartments."

2.3 SHOWER RECEPTORS

A. General: Manufacturer's standard, prefabricated, terrazzo receptor complete with integral drain.

1. Provide each unit with a ramped entrance surface for accessible compartments.
2. Drain Strainer: Manufacturer's standard; removable.
3. Drain Gasket: Manufacturer's standard gasket sized to fit waste pipe.

B. Finish: Manufacturer's standard finish on exposed surfaces, matching color of enclosure panels, as indicated by manufacturer's designations or as selected by Architect from manufacturer's full range and with slip-resistant floor surface texture.

2.4 ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's standard design, heavy-duty, operating hardware and accessories. Mount to panels with through-bolts.

1. Material: As directed Clear-anodized aluminum, Stainless steel or Chrome-plated brass.
2. Hinges: Manufacturer's standard, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, continuous, cam type that swings to a closed or partially open position, continuous, spring-loaded type or integral hinge for solid-plastic doors, allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard, recessed or surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. As directed Provide units that comply with regulatory requirements for accessibility at each compartment, accessible or not or at compartments designated as accessible.
4. Clothing Hooks: Manufacturer's standard clothing hooks in each dressing compartment; include one combination hook and rubber-tipped bumper at inswinging doors, sized to prevent door from hitting wall panel or compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard, rubber-tipped bumper at outswinging doors.
6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with antigrip profile; in manufacturer's standard finish.

C. Headrail with Hooks: Manufacturer's standard, continuous, extruded-aluminum headrail or cap with curtain hooks running in concealed track; with antigrip profile; in manufacturer's standard finish.

D. Curtain Rod with Hooks: Manufacturer's standard, 1-inch- (25-mm-) diameter, stainless steel curtain rod with matching hooks.

E. Curtain: As directed Flame-resistant, polyester-reinforced vinyl fabric or manufacturer's standard fabric that is stain resistant, self-sanitizing, antistatic, antimicrobial, and launderable to a temperature of not less than 90 deg F (32 deg C).

1. Flame Resistance: Passes NFPA 701 tests when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Labeling: Identify fabrics with appropriate markings of applicable testing and inspecting agency.
3. Length: Where curtain extends to a floor surface, size so that bottom hem clears finished floor by not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) above floor surface. Where curtains extend to a shower-receptor curb, size so that bottom hem hangs above curb line and clears curb line by not more than 1/2 inch (13 mm).

4. Color and Pattern: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

F. Soap Holder: As directed Surface-mounted or Recessed, seamless stainless steel soap dish.

G. Seats: As directed Manufacturer's standard, panel-mounted, wall-mounted or floor-mounted benches.

1. Material: As directed Wood, Solid phenolic, Molded plastic or Stainless steel.
2. Operation: As directed Fixed or Folding.
3. Finish: As indicated by manufacturer's designations, Match Architect's sample, As selected by Architect from manufacturer's full range or Match enclosure panels.

H. Anchorages and Fasteners: Manufacturer's standard, exposed fasteners of stainless steel, chrome-plated steel, or solid brass, finished to match the items they are securing; with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications.

2.5 FABRICATION

A. Overhead-Braced Compartments: Manufacturer's standard, corrosion-resistant supports, leveling method, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling method.

B. Floor-and-Ceiling-Anchored Compartments: Manufacturer's standard, corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

C. Door Sizes and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard shower and dressing compartments, and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install compartments rigid, straight, level, and plumb. Secure compartments in position with manufacturer's recommended anchoring devices.

1. Clearances for Dressing Compartments: Maximum 1/2 inch (13 mm) between pilasters and panels; 1 inch (25 mm) between panels and walls.
2. Stirrup Brackets for Dressing Compartments: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets for Dressing Compartments: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Curtains: Install curtains to specified length, verify that they hang vertically without stress points or diagonal folds.

C. Shower Receptors: Install prefabricated shower receptors with drain gasket compression fit to OD of waste pipe.

3.2 ADJUSTING

A. Curtain Adjustment: After hanging curtains, test and adjust each track or rod to produce unencumbered, smooth operation. Steam and dress down curtains as required to produce crease- and wrinkle-free installation. Remove and replace curtains that are stained or soiled or that have stress points or diagonal folds.

B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102116.19

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cubicle-curtain tracks and carriers.
2. Cubicle curtains.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:

1. Laundering: Launderable to a water temperature of not less than 160 deg F (71 deg C).
2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.

    a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

A. Extruded-Aluminum Curtain Track: As directed Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high) or 5/8 inch wide by 1/2 inch high (16 mm wide by 13 mm high).

1. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.
2. Finish: As directed Clear anodized, Satin anodized or Baked enamel, acrylic, or epoxy.

B. PVC Curtain Track: Not less than 1-1/4 inches wide by 15/16 inch high (32 mm wide by 24 mm high).

1. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.

C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. End Stop: As directed Nonremovable or Removable with carrier hook.

D. Curtain Roller Carriers: As directed Two nylon rollers and nylon axle with chrome-plated steel, nylon or aluminum hook.

E. Curtain Glide Carriers: As directed One-piece nylon glide with chrome-plated steel or nylon hook.

F. Breakaway Curtain Carriers: As directed One-piece nylon or Velcro breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 5 lbf (22.2 N).

G. Exposed Fasteners: Stainless steel.

H. Concealed Fasteners: As directed Hot-dip galvanized or Stainless steel.

2.3 CURTAINS

A. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.

1. Proprietary Fiber:

2. Pattern: As directed.
3. Width: As directed.
4. Color: As selected by Architect from manufacturer's full range.

B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.

C. Mesh Top: As directed Not less than 20-inch- (508-mm-) or 22-inch- (559-mm-) high mesh top.

1. Mesh: No. As directed 50, 40 or 42 nylon mesh.

D. Beaded-Chain Curtain Drop: As directed 6 inches (152 mm), 9 inches (229 mm), 12 inches (305 mm), 15 inches (381 mm) or 18 inches (457 mm) long; nickel-plated steel with aluminum hook.

E. PVC-Strip Curtain Drop: As directed 16 inches (406 mm) or 18 inches (457 mm) long with chrome-plated steel hook.

F. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.

G. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

A. Continuous Curtain Panels:

1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches (305 mm) of added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches (305 mm), 15 inches (381 mm) or As indicated on Drawings.

B. Modular Curtain Panels:

1. Fabric Panels: As directed 48 inches (1219 mm) or 66 inches (1676 mm) wide. Fabricate panels in quantity required to provide assembled curtains equal to track lengths plus 10 percent added fullness, but not less than 12 inches (305 mm) added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches (305 mm), 15 inches (381 mm) or As indicated on Drawings.
3. Mesh Top: As directed Continuous for each track length, matching overall width of assembled curtains or Modular, matching width of modular fabric panels with snap attachments at side hems of mesh-top panels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install tracks level and plumb, according to manufacturer's written instructions.

B. For tracks of up to 20 feet (6.0 m) in length, provide track fabricated from single, continuous length.

1. Curtain-Track Mounting: As directed Surface, Suspended or As indicated on Drawings.

C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

1. Provide one hinged loading unit for each bed.

D. Curtain Carriers: Provide curtain carriers adequate for 6-inch (152-mm) spacing along full length of curtain plus an additional carrier.

E. Cubicle Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION 102123

SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-duty wire mesh partitions.
2. Heavy-duty wire mesh partitions.
3. Wire mesh ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.

D. Samples: For units with factory-applied color finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

A. Steel Wire: ASTM A510 (ASTM A510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.

D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.

E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513, Type 5, mandrel-drawn mechanical tubing.

F. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

G. Seismic Bracing: Angles with legs not less than 1-1/4 inch (32 mm) wide, formed from 0.040-inch- (1.0-mm-) thick, metallic-coated steel sheet; with bolted connections and 1/4-inch- (6-mm-) diameter bolts.

H. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

I. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.

J. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.3 STANDARD-DUTY WIRE MESH PARTITIONS

A. Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond mesh.

B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm) cold-rolled, C-shaped steel channels with holes for 1/4-inch- (6-mm-) diameter bolts not more than 12 inches (300 mm) o.c.

C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm) cold-rolled steel channels.

D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 3/4 by 3/8 by 1/8 inch (19 by 9.5 by 3.2 mm), bolted or riveted toe to toe through mesh or one 1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm) cold-rolled steel channel with wire mesh woven through channel.

E. Top Capping Bars: 2-1/4-by-1-inch (57-by-25-mm) cold-rolled steel channels.

F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel angles or square tubes with holes for 1/4-inch- (6-mm-) diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.

G. Posts for Other-Than-90-Degree Corners: Steel pipe or tubing with holes for 1/4-inch- (6-mm-) diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.

1. Partitions up to 12 Feet (3.7 m) High: 1-1/4-inch (32-mm) OD by 1/8 inch (3.2 mm).
2. Partitions up to 20 Feet (6.1 m) High: 2-1/2-inch (65-mm) OD by 1/8 inch (3.2 mm).

H. Adjustable Corner Posts: Two 1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm) cold-rolled, C-shaped steel channels connected by steel hinges at 36 inches (900 mm) o.c., with holes for 1/4-inch- (6-mm-) diameter bolts aligning with bolt holes in vertical framing.

I. Line Posts: 3-inch-by-4.1-lb (76-mm-by-1.9-kg) or 3-1/2-by-1-1/4-by-0.127-inch (89-by-32-by-3.2-mm) steel channels; with 1/4-inch (6.4-mm) steel base plates.

J. Three-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel tubes or channels, with holes for 1/4-inch- (6-mm-) diameter bolts aligned for bolting to adjacent panels.

K. Four-Way Intersection Posts: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel tubes, with holes for 1/4-inch- (6-mm-) diameter bolts aligned for bolting to adjacent panels.

L. Floor Shoes: Metal, not less than 2 inches (50 mm) high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.

M. Swinging Dutch Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels or 1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm) cold-rolled, C-shaped steel channels, banded with 1-1/4-by-1/8-inch (32-by-3.2-mm) flat steel bar cover plates on three or four sides as directed, and with 1/8-inch- (3.2-mm-) thick angle strike bar and cover on strike jamb.

1. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, three per door; bolted, riveted, or welded to door and jamb framing.
2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
3. Cylinder Lock: Mortise type with manufacturer's standard cylinder, cylinder specified in Section 087100 "Door Hardware" or cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)"; operated by key outside and recessed turn knob, knob or lever inside.

N. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm) steel channels, banded with 1-1/2-by-1/8-inch (38-by-3.2-mm) flat steel bar cover plates on four sides.

1. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
3. Cylinder Lock: As directed Mortise type with manufacturer's standard cylinder, cylinder specified in Section 087100 "Door Hardware", cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)"; operated by key outside and recessed turn knob, knob or lever inside.

O. Vertically Sliding Service Windows: As directed Fabricated from same mesh and framing as panels and equipped with a spring catch or slide bolts on each jamb to lock window in open position and a padlock lug to lock window in closed position. Include opening frame in partition fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels.

P. Swinging Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch on strike jamb that locks window in closed position. Include opening frame in partition fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels.

Q. Accessories:

1. Sheet Metal Base: As directed 0.060-inch- (1.5-mm-) or 0.035-inch- (0.9-mm-) thick steel sheet.
2. Adjustable Filler Panels: 0.060-inch- (1.5-mm-) thick steel sheet, capable of filling openings from 2 to 12 inches (50 to 300 mm).

R. Finish: As directed Hot-dip galvanized, Shop primed for field painting, Enamel finish or Powder-coated finish unless otherwise indicated.

1. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

2.4 HEAVY-DUTY WIRE MESH PARTITIONS

A. Mesh: 0.192-inch- (4.9-mm-) diameter steel wire woven into 2-inch (50-mm) diamond mesh or welded into 1-1/2-by-2-1/2-inch (38-mm-by-65-mm) rectangular mesh.

B. Vertical and Horizontal Panel Framing: 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm) cold-rolled steel channels; with holes for 3/8-inch- (9.5-mm-) diameter bolts not more than 12 inches (300 mm) o.c.

C. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 1 by 1/2 by 1/8 inch (25 by 13 by 3.2 mm), bolted or riveted toe to toe through mesh.

D. Top Capping Bars: 3-by-1-inch (76-by-25-mm) steel channels.

E. Posts for 90-Degree Corners: 1-1/2-by-1-1/2-by-1/8-inch (38-by-38-by-3.2-mm) steel angles or tubes or 2-by-2-by-0.075-inch (50-by-50-by-1.9-mm) cold-rolled steel angles or tubes, with holes for 3/8-inch- (9.5-mm-) diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch (6.4-mm) steel base plates.

F. Posts for Other-Than-90-Degree Corners: 2-inch- (50-mm) OD by 1/8-inch (3.2-mm) steel pipe or round tube, with holes for 3/8-inch- (9.5-mm-) diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch (6.4-mm) steel base plates.

G. Adjustable Corner Posts: Two 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm) cold-rolled, steel channels or 2-by-2-by-0.075-inch (50-by-50-by-1.9-mm) steel tubes connected by steel hinges at 36 inches (900 mm) o.c. attached to posts; with 1/4-inch- (6-mm-) diameter bolt holes aligning with bolt holes in vertical framing; with 1/4-inch (6.4-mm) steel base plates.

H. Line Posts: 3-inch-by-4.1-lb (76-mm-by-1.9-kg) or 3-1/2-by-1-1/4-by-1/8-inch (89-by-32-by-3.2-mm) steel channels; with 1/4-inch (6.4-mm) steel base plates.

I. Three- and Four-Way Intersection Posts: 2-by-2-by-0.075-inch (50-by-50-by-1.9-mm) steel tubes, with holes for 3/8-inch- (9.5-mm-) diameter bolts aligned for bolting to adjacent panels; with 1/4-inch (6.4-mm) steel base plates.

J. Floor Shoes: Metal, not less than 2 inches (50 mm) high; sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.

K. Swinging Dutch Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm) steel channels, banded with 1-1/2-by-1/8-inch (38-by-3.2-mm) flat steel bar cover plates on four sides, and with 1/8-inch- (3.2-mm-) thick angle strike bar and cover on strike jamb.

1. Hinges: Full-surface type, 3-1/2-by-3-1/2-inch (89-by-89-mm) steel, three per door; bolted, riveted, or welded to door and jamb framing.
2. Padlock Lug: Mortised into door framing and enclosed with steel cover.

3. Cylinder Lock: As directed Mortise type with manufacturer's standard cylinder, cylinder specified in Section 087100 "Door Hardware" or cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)"; operated by key outside and recessed turn knob, knob or lever inside; mounted in lower section of door.

L. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch (38-by-19-by-3.2-mm) steel channels, banded with 1-1/2-by-1/8-inch (38-by-3.2-mm) flat steel bar cover plates on four sides.

1. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.
2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
3. Cylinder Lock: As directed Mortise type with manufacturer's standard cylinder, cylinder specified in Section 087100 "Door Hardware" or cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)"; operated by key outside and recessed turn knob, knob or lever inside; mounted in lower section of door.

M. Vertically Sliding Service Windows: As directed Fabricated from same mesh and framing as panels and equipped with a spring catch or slide bolts on each jamb to lock window in open and closed positions. Include opening frame in partition fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels.

N. Swinging Service Windows: Fabricated from same mesh and framing as panels and equipped with spring catch on strike jamb that locks window in closed position. Include opening frame in partition fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels.

O. Accessories:

1. Sheet Metal Base: 0.060-inch- (1.5-mm-) thick, steel sheet.
2. Adjustable Filler Panels: 0.060-inch- (1.5-mm-) thick steel sheet, capable of filling openings from 2 to 12 inches (50 to 300 mm).

P. Finish: As directed Hot-dip galvanized, Shop primed for field painting, Enamel finish or Powder-coated finish unless otherwise indicated.

1. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

2.5 WIRE MESH CEILINGS

A. Mesh, Framing, and Stiffeners: Fabricated from same mesh and framing as wire mesh partition panels.

B. Perimeter Partition Supports: As directed 1-1/2-by-1-1/2-by-1/8-inch (38-by-38-by-3.2-mm) or 1-1/2-by-1-1/2-by-0.075-inch (38-by-38-by-1.9-mm) steel angle, with holes for 1/4-inch- (6-mm-) diameter bolts aligned for bolting to top of wire mesh partitions and to sides of wire mesh ceiling panels.

C. Wall Supports: As directed 1-1/2-by-1-1/2-by-1/8-inch (38-by-38-by-3.2-mm) or 1-1/2-by-1-1/2-by-0.075-inch (38-by-38-by-1.9-mm) steel angle punched for attachment to wall and wire mesh ceiling panels.

D. Intermediate Supports: Steel I-beams or rectangular tubes, as recommended by manufacturer.

E. Intermediate Support Posts: As directed 2-by-2-by-1/8-inch (50-by-50-by-3.2-mm) or 2-by-2-by-0.075-inch (50-by-50-by-1.9-mm) steel tubes.

F. Finishes: Match adjacent wire mesh partitions.

2.6 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.
2. Welding: As directed Weld corner joints of framing and grind smooth, leaving no evidence of joint, finish sand, remove spatter or leave as applied.

B. Standard- and Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: As directed Securely clinch or Weld mesh to framing.
2. Framing: Fabricate framing with mortise and tenon corner construction.

    a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.

3. Fabricate wire mesh partitions with 3 to 4 inches (75 to 100 mm) of clear space between finished floor and bottom horizontal framing.
4. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
5. Doors: Align bottom of door with bottom of adjacent panels.

    a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.

6. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

C. Wire Mesh Ceilings: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: As directed Securely clinch or Weld mesh to framing.
2. Framing: As directed Fabricate framing with mortise and tenon or welded corner construction.

a. Provide stiffeners as indicated or, if not indicated, as required by panel span and as recommended by wire mesh ceiling manufacturer. Weld stiffeners to framing.

2.7 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

B. Preparation for Shop Priming: As directed Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" or SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel finish, suitable for use indicated, with a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

E. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 WIRE MESH PARTITIONS ERECTION

A. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter postinstalled expansion anchors at 12 inches (300 mm) o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.

B. Anchor wire mesh partitions to floor with 3/8-inch- (9.5-mm-) diameter postinstalled expansion anchors at 12 inches (305 mm) o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.

C. Anchor wire mesh partitions to walls at 12 inches (305 mm) o.c. through back corner panel framing.

D. Secure top capping bars to top framing channels with 1/4-inch- (6-mm-) diameter "U" bolts spaced not more than 28 inches (700 mm) o.c.

E. Provide line posts at locations indicated.

F. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

G. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

H. Install doors complete with door hardware.

I. Install service windows complete with window hardware.

J. Weld or bolt sheet metal bases to wire mesh partitions and doors or where indicated.

3.2 WIRE MESH CEILINGS ERECTION

A. Anchor wall support angle to walls at 12 inches (300 mm) o.c.

B. Attach wire mesh ceiling panels to wall support angles with bolts at 12 inches (305 mm) o.c.

C. Attach wire mesh ceiling panels to wire mesh partitions with slotted angles bolted to sides of ceiling panels and to top of partitions at 12 inches (305 mm) o.c.

D. Attach wire mesh ceiling panels to intermediate supports as recommended by manufacturer.

E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

3.3 ADJUSTING AND CLEANING

A. As directed Adjust doors, gates or service windows to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 102213

SECTION 102219 - DEMOUNTABLE PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Site-assembled demountable partitions.
2. Unitized-panel demountable partitions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For demountable partitions.

1. Include diagrams for power-, signal-, and control-wiring raceways.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from the installers of the items involved:

B. Product certificates.

C. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Partition Components: Furnish a quantity of each type of full-size unit with installation tools and materials equal to one or two as percent as directed of the amount installed, but no fewer than as directed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Acoustical Performance: Where acoustical rating is indicated, provide demountable-partition assembly tested by a qualified testing agency for sound transmission loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

2.2 SITE-ASSEMBLED DEMOUNTABLE PARTITIONS

A. General: Site-assembled, demountable-partition assembly and components that are the standard products of manufacturer.

B. Acoustical Rating: STC 35.

C. Face Panels: Manufacturer's standard substrate as directed.

1. Finish: As directed.

    a. Color: As directed.

2. Facing: As directed.

    a. Color, Texture, and Pattern: As directed.
    b. Wood-Veneer Species and Finish: White ash, Red oak or Birch as directed with transparent finish or transparent finish over stain.

D. Accessory Panels: Manufacturer's standard as directed.

E. Framing: Metallic-coated steel or aluminum studs and top and bottom tracks, as directed.

F. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor level or floor and ceiling levels as directed.

1. Exposed-Metal Trim Finish: As directed
2. Trim Color: As directed.

G. Doors: As specified in Section 081113 "Hollow Metal Doors and Frames", As specified in Section 081416 "Flush Wood Doors" or As specified in Section 081433 "Stile and Rail Wood Doors" as directed.

H. Doors: Manufacturer's standard 1-3/4-inch- (45-mm-) thick door construction as directed.

1. Door Operation: As directed.
2. Door Finish: As directed match face panels of partition, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Plastic laminate or Wood veneer.

    a. Color, Texture, and Pattern: As directed.
    b. Wood-Veneer Species and Finish: As directed White ash, Red oak or Birch with transparent finish or transparent finish over stain.

I. Door Frames: Manufacturer's standard steel or aluminum frames as directed for 1-3/4-inch (45-mm) doors.

1. Frame Finish: As directed Match metal face panels, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Clear-anodized aluminum or Color-anodized aluminum.
2. Frame Color: As directed.

J. Door Hardware: As directed

K. Glazing Frames: Manufacturer's standard steel or aluminum frames as directed for frameless (top and bottom-supported) glazing thickness indicated.

1. Frame Finish: As directed Match door frames, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Clear-anodized aluminum or Color-anodized aluminum.
2. Frame Color: As directed.

L. Glazing: Manufacturer's standard fully tempered clear float glass, insulating, fully tempered clear float glass, laminated clear float glass or as directed.

M. Frameless Glazing: Manufacturer's standard fully tempered clear float glass, laminated clear float glass or as directed for butt-glazing with top and bottom support.

N. Electrical Devices: Integral, concealed raceways to serve electrical power and communication devices indicated on Drawings.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 UNITIZED-PANEL DEMOUNTABLE PARTITIONS

A. General: Unitized, demountable-partition assembly and components that are the standard products of manufacturer.

B. Acoustical Rating: STC 35.

C. Unitized Panels: Manufacturer's standard gypsum board, particleboard, steel-sheet-faced gypsum board or stainless-steel-sheet-faced gypsum board or as directed.

1. Finish: Unfinished, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish or No. 4 satin polish on stainless steel as directed.

    a. Color: As directed.

2. Facing: Vinyl wall covering, Fabric, Carpet wall covering, Plastic laminate, Wood veneer or Owner-furnished material as directed.

    a. Color, Texture, and Pattern: As directed.
    b. Wood-Veneer Species and Finish: As directed White ash, Red oak or Birch with transparent finish or transparent finish over stain.

D. Accessory Panels: As directed Manufacturer's standard fabric-covered tackboard, porcelain-enamel markerboard or porcelain-enamel chalkboard.

E. Framing: As directed Manufacturer's standard, Steel or Aluminum.

1. Exposed Finish: As directed Match unitized panels, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Clear-anodized aluminum or Color-anodized aluminum.
2. Color of Exposed Finish: As directed.

F. Trim: Continuous, factory-finished, snap-on type; adjustable for variations in floor level or floor and ceiling levels as directed.

1. Exposed-Metal Trim Finish: As directed Match unitized panels, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, No. 4 satin polish on stainless steel, Clear-anodized aluminum or Color-anodized aluminum.
2. Trim Color: As directed.

G. Doors: Manufacturer's standard 1-3/4-inch- (45-mm-) thick, steel, solid-core wood, framed glass or frameless glass door construction as directed.

1. Door Operation: Pivoting, Sliding or Swinging as directed.
2. Door Finish: Match face panels of partition, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Plastic laminate or Wood veneer as directed.

    a. Color, Texture, and Pattern: As directed.
    b. Wood-Veneer Species and Finish: As directed White ash, Red oak or Birch with transparent finish or transparent finish over stain.

H. Door Frames: As directed Manufacturer's standard steel or aluminum frames for 1-3/4-inch (45-mm) doors.

1. Frame Finish: As directed Match metal face panels, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Clear-anodized aluminum or Color-anodized aluminum.
2. Frame Color: As directed.

I. Door Hardware: As directed.

J. Glazing Frames: As directed Manufacturer's standard steel or aluminum frames for frameless (top and bottom-supported) glazing thickness indicated.

1. Frame Finish: As directed Match door frames, Factory primed for field painting, Factory-applied, baked-enamel or powder-coat finish, Clear-anodized aluminum or Color-anodized aluminum.
2. Frame Color: As directed.

K. Glazing: As directed Manufacturer's standard fully tempered clear float glass, insulating, fully tempered clear float glass, laminated clear float glass or glass as indicated on Drawings.

L. Frameless Glazing: Manufacturer's standard fully tempered clear float glass, laminated clear float glass or glass as indicated on Drawings as directed for butt-glazing with top and bottom support.

M. Electrical Devices: Integral, concealed raceways to serve electrical power and communication devices indicated on Drawings.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 WOOD MATERIALS

A. Particleboard: Panels complying with ANSI A208.1, Grade M-2.

1. Fire-retardant panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested according to ASTM E84 or UL 723.

B. Wood Veneer: Genuine wood veneer; clear, vertical grain, straight, and kiln dried; of wood species indicated, laminated to panel substrate with moisture-resistant adhesive.

2.5 OTHER MATERIALS

2.6 FABRICATION

A. General: Fabricate demountable walls for installation with concealed fastening devices and pressure-fit members that will not damage ceiling or floor coverings. Fabricate systems for

installation with continuous seals at floor, ceiling, and other locations where partitions abut fixed construction.

B. Panels for Site-Assembled Demountable Partitions: Face panels fabricated and finished in modular widths indicated.

C. Panels for Unitized-Panel Demountable Partitions: Factory-assembled, flush, unitized-panel construction; with faces smooth and free of buckles, oil-canning, and seams; and insulated with solidly packed, inorganic, mineral filler.

1. Factory glaze panels to the greatest extent possible.

D. Finish Facings: Factory apply finish-facing materials with appropriate backings, using mildew-resistant nonstaining adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install demountable partitions after other finishing operations have been completed.

1. Install partitions rigid, level, plumb, and aligned. Install seals at connections with floors, ceilings, fixed walls, and abutting surfaces to prevent light and sound transmission.
2. Except for filler panels scribed to fixed walls or columns, do not modify manufacturer's standard components.

B. Suspended-Ceiling System: As directed Do not alter suspended-ceiling system or Make alterations to suspended-ceiling system required by partition installation or to gain access to electrical or communication systems without affecting the structural integrity of suspended-ceiling system. Make alterations so they are not noticeable after panel installation.

3.2 DEMONSTRATION

A. As directed Engage a factory-authorized service representative to train or Train Owner's maintenance personnel to adjust, assemble, disassemble, and maintain demountable partitions.

END OF SECTION 102219

SECTION 102233 - ACCORDION FOLDING PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, accordion folding partitions.
2. Manually operated, fire-rated accordion folding partitions.
3. Electrically operated, accordion folding partitions.
4. Electrically operated, fire-rated accordion folding partitions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. As directed.

C. Shop Drawings: For accordion folding partitions.

1. Include plans, elevations, sections, and attachment details.
2. Indicate storage and operating clearances.
3. Indicate facing-material seam locations if any.
4. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, based on input from installers of the items involved:

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Product certificates.

D. Material certificates: For each textile dye lot.

E. Product test reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of accordion folding partitions that fail in materials or workmanship within specified warranty period.

1. Warranty Period: As directed Two or Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide accordion folding partitions tested by a qualified testing agency for the following acoustical properties, according to test methods indicated:

1. Sound-Transmission Requirements: Accordion folding partition assembly tested in a laboratory for sound-transmission loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.
2. Noise-Reduction Requirements: Accordion folding partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C423, and rated for not less than the NRC indicated.

B. Fire-Test-Response Characteristics: Provide partitions with finishes complying with one of the following, as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

C. Fire Resistance: Provide fire-rated accordion folding partitions complying with NFPA 80, based on testing according to UL 10B for fire-rated door assemblies.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 ACCORDION FOLDING PARTITION

A. Accordion Folding Partition: Accordion folding frame with pantograph or hinged sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.

B. Partition Type: As indicated on Drawings, with the following hardware:

1. Lead Post Latching Hardware: As directed Latch on one side, Latch on one side with coin-slot release on opposite side or Latch on both sides secured to recessed jamb striker, surface jamb striker or meeting post striker.
2. Lead Post Locking Hardware: Key-operated lock cylinder, keyed to master key system, operable from latch side or both sides of post.
3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from latch side or both sides of post As directed. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

C. STC: As directed 30, 35, 40 or 45.

D. NRC: Not less than As directed 0.50, 0.70 or 0.85.

E. Electric Controls: As directed Remote-control station, Two remote-control stations, Obstruction-detection device and emergency release mechanism.

F. Facing Material: As directed Carpet wall covering, Fabric, Vinyl-coated fabric, Vinyl film, Plastic laminate, Wood veneer or Paint.

1. Color/Pattern: Match Architect's samples or As selected by Architect from manufacturer's full range.

2.3 FIRE-RATED ACCORDION FOLDING PARTITION

A. Fire-Rated Accordion Folding Partition: Accordion folding frame with pantograph sections designed for horizontal extension and retraction, covered with decorative facing material, reinforced for hardware attachment, supported by overhead suspension system, and equipped with manufacturer's standard air-release method to prevent billowing.

B. Partition Type: As indicated on Drawings, with the following hardware:

1. Lead Post Latching Hardware: As directed Latch on one side, Latch on one side with coin-slot release on opposite side or Latch on both sides secured to recessed jamb striker.
2. Lead Post Locking Hardware: As directed Key-operated lock cylinder, keyed to master key system, operable from latch side or both sides of post.

3. Lead Post Locking Hardware: Deadlock to receive cylinder, operable from latch side or both sides of post. See Section 087100 "Door Hardware" and Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

C. Fire Rating: As directed 3/4 hour, 1 hour, 1-1/2 hours or 3 hours.

D. STC: As directed 30, 40 or 44.

E. NRC: Not less than As directed.

F. Electric Controls: As directed Remote-control station, Two remote-control stations, Obstruction-detection device and emergency release mechanism.

G. Facing Material: As directed Vinyl film or Paint.

1. Color/Pattern: As directed Match Architect's samples or As selected by Architect from manufacturer's full range.

2.4 COMPONENTS

A. Posts and Seals: Provide types of posts and seals that produce accordion folding partitions complying with performance requirements.

1. Posts: Steel or aluminum; formed with deep-nesting and interlocking interfaces and fabricated to ensure rigidity of accordion folding partition.
2. Perimeter Seals: Manufacturer's standard vinyl, neoprene, or woven silica vertical seals, horizontal top and bottom seals, and closures for lead posts and jambs. Seals and closures at fire-rated partitions shall be identical to products tested for fire rating indicated and shall form an effective smoke and draft seal.

B. Hardware: Manufacturer's standard manually operated pulls, latches, locks, and bolts as required to operate accordion folding partitions; with decorative, protective finish.

2.5 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum, designed for operation, size, and weight of accordion folding partition indicated. Size track to support partition operation and storage without damage to suspension system, accordion folding partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Track: As directed Surface mounted or Recessed.

a. Head Closure Trim: Integral with track for protecting overhead surfaces; with factory-applied, decorative, protective finish or primed for field finish.
b. Head Closure Trim and Track Channel Pocket: For protecting overhead surfaces and enclosing overhead track opening; with factory-applied, decorative, protective finish or primed for field finish.

B. Carriers: As directed Trolley system as required for size and weight of partition and for easy, quiet operation; with four-wheel, six-wheel, 12-wheel or manufacturer's standard ball-bearing carriers at lead post and two-wheel or manufacturer's standard ball-bearing carriers at intermediate partition supports.

1. Wheels: As directed Nylon, Steel or Manufacturer's standard.

C. Track Switches and Accessories: Manufacturer's standard switches as required for type of operation, storage, track configuration, and layout indicated.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ELECTRIC OPERATORS

A. Factory-assembled electric operation system of size and capacity recommended and provided by accordion folding partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, remote-control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Comply with NFPA 70.

C. Motor Electrical Characteristics:

1. Horsepower: As directed ¼, 1/3, ¾ or Manufacturer's standard.
2. Volts: As directed 115 or 208.
3. Phase: As directed Single phase or Polyphase.
4. Hertz: 60.

D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

E. Remote-Control Station: For partitions indicated, provide manufacturer's standard key-operated, constant-pressure, three-position control station labeled "Open," "Close," and "Off or Stop." Provide two keys per station.

F. Limit Switches: Provide each partition with adjustable switches, interlocked with motor controls and set to automatically stop accordion folding partition at fully extended and fully stacked positions.

G. Emergency Release Mechanism: For partitions indicated, provide quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

2.7 WOOD MATERIALS, GENERAL

A. As directed.

2.8 FACING MATERIALS

A. Provide facing materials with appropriate backing that comply with indicated fire-test-response characteristics, and that are factory attached to accordion folding partitions with concealed fasteners.

1. Factory-apply facing material free of air bubbles, wrinkles, blisters, and other defects; in one piece, seamless; with vertical invisible seams complying with Shop Drawings for location; and with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing material for finished appearance. Horizontal butted edges or seams are not permitted.
2. Where facing material with directional or repeating patterns or directional weave or directional, repeating, or matching grain are indicated, mark facing-material top and attach facing material in same direction.

B. Carpet Wall Covering: Manufacturer's standard nonwoven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.

C. Fabric: Manufacturer's standard fabric or 100 percent polyolefin woven fabric, from same dye lot, treated to resist stains.

D. Vinyl-Coated Fabric: Manufacturer's standard mildew-resistant, washable, vinyl-coated fabric wall covering; complying with WA-101, Type II-Medium Duty or Type III-Heavy Duty; Class A.

E. Vinyl Film: Manufacturer's standard vinyl film laminated to partition substrate.

F. Plastic Laminate: High-pressure decorative laminate; NEMA LD 3, Grade HGS.

G. Wood Veneer: Laminated to noncombustible or fire-retardant-treated wood core with moisture-resistant adhesive.

1. Wood Species and Finish: As directed Match Architect's sample, As selected by Architect from manufacturer's full range, Cherry, Maple, Poplar or Red oak with transparent finish, transparent finish over stain or wood finish as specified in Section 099300 "Staining and Transparent Finishing.".

H. Paint: Manufacturer's standard baked enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with accordion folding partition manufacturer's written installation instructions. Install accordion folding partitions level and plumb, with tight joints and uniform appearance, and free of deformation and surface and finish irregularities.

B. Install accordion folding partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Light-Leakage Test: Illuminate one side of partition installation, and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

D. Verify that safety devices are properly functioning.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain accordion folding partitions.

END OF SECTION 102233

SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, acoustical panel partitions.
2. Electrically operated, acoustical panel partitions.
3. Manually operated, fire-rated panel partitions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, attachment details, and numbered panel installation sequence.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. Include diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified.

E. Delegated-Design Submittal: For operable panel partitions.

1. Include design calculations for seismic restraints that brace tracks to structure above.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer.

D. Product Certificates: For each type of operable panel partition.

E. Product test reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Warranty Period: As directed Two, Five or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.
2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C423, and rated for not less than the NRC indicated.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

E. Fire Resistance: Provide fire-rated operable panel partition assemblies including pass doors complying with NFPA 80, based on testing according to UL 10B for fire-rated door assemblies.

1. Pass doors in fire-rated operable panel partition assemblies shall meet positive-pressure requirements.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

B. Panel Operation: Manually operated, individual, Manually operated, paired, Manually operated, continuously hinged or Electrically operated, continuously hinged panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

E. STC: As directed Not less than 38, 41, 45, 47, 50, 52, 54 or 56.

F. NRC: As directed Not less than 0.50, 0.60, 0.65 or 0.90.

G. Panel Materials:
1. Steel Frame: Steel sheet, manufacturer's standard thickness.
2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard thickness.
3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; manufacturer's standard strengths and thicknesses for type of use.

4. Gypsum Board: ASTM C1396/C1396M.
5. Cement Board: ASTM C1288.
6. Particleboard: ANSI A208.1.
7. Medium-Density Fiberboard: ANSI A208.2.
8. Plywood: DOC PS 1.

H. Panel Closure: Manufacturer's standard.

I. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

J. Finish Facing: As directed Vinyl-coated fabric wall covering, Carpet wall covering, Fabric wall covering, High-pressure decorative laminate, Wood veneer or Paint.

2.3 OPERABLE FIRE-RATED PANELS

A. Operable Fire-Rated Panels: Fire-rated, acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

B. Panel Operation: As directed Manually operated, individual or paired panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable fire-rated panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

E. Fire Rating: 1 hour(s).

F. STC: As directed Not less than 38, 41, 45, 47, 50, 52 or 54.

G. NRC: As directed Not less than 0.50, 0.60, 0.65 or 0.90.

H. Panel Materials:
1. Steel Frame: Steel sheet, manufacturer's standard thickness.
2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard thickness.

I. Panel Closure: Manufacturer's standard.

J. Hardware: Manufacturer's standard as required to operate fire-rated operable panel partition and accessories; with decorative, protective finish.

K. Finish Facing: As directed Vinyl-coated fabric wall covering, Carpet wall covering, Fabric wall covering, High-pressure decorative laminate, Wood veneer or Paint.

2.4 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:

1. Seals made from materials and in profiles that minimize sound leakage.
2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

C. Horizontal Bottom Seals: Resilient, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.

1. Mechanically Operated for Acoustical Panels: As directed Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2 inches (38 mm), 2 inches (50 mm), 4 inches (102 mm) or 6 inches (152 mm) between retracted seal and floor finish.
2. Mechanically Operated for Fire-Rated Panels: As directed Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2 inches (38 mm), 2 inches (50 mm) or 4 inches (102 mm) between retracted seal and floor finish.
3. Automatically Operated for Acoustical Panels: As directed Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1 inch (25 mm), 1-1/2 inches (38 mm) or 2 inches (50 mm) between retracted seal and floor finish.

2.5 PANEL FINISH FACINGS

A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

B. Vinyl-Coated Fabric Wall Covering: As directed Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with WA-101, Type I-Light Duty, Type II-Medium Duty or Type III-Heavy Duty; Class A.

1. Color/Pattern: Match Architect's samples or As selected by Architect from manufacturer's full range.

C. Carpet Wall Covering: Manufacturer's standard, from same dye lot, treated to resist stains.

1. Color/Pattern: Match Architect's samples or As selected by Architect from manufacturer's full range.

D. Fabric Wall Covering: As directed Manufacturer's standard fabric or 100 percent polyolefin woven fabric, from same dye lot, treated to resist stains.

1. Color/Pattern: Match Architect's samples or As selected by Architect from manufacturer's full range.

E. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.

1. Color/Pattern: As directed Match Architect's samples or As selected by Architect from manufacturer's full range.

F. Wood Veneer: Laminated to noncombustible or fire-retardant-treated wood core with moisture-resistant adhesive.

1. Species, Cut, and Finish: As selected by Architect from manufacturer's full range.

G. Paint: Manufacturer's standard factory-painted finish.

1. Color: Match Architect's sample or As selected by Architect from manufacturer's full range.

H. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.

I. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.6 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

2.7 ELECTRIC OPERATORS

A. Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and

accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Comply with NFPA 70.

C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

D. Motor Electrical Characteristics:

1. Horsepower: Manufacturer's standard.
2. Volts: As directed 115, 208, 230 or 460.
3. Phase: As directed Single phase or Polyphase.
4. Hertz: 60.

E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. As directed Each three-position control station labeled "Open," "Close," and "Off or Stop." Furnish two keys per station.

F. Obstruction-Detection Devices: As directed Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately shut off motor or stop and reverse direction.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.

H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.
2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

2.8 ACCESSORIES

A. Pass Doors: As directed Swinging door built into and matching panel materials, construction, acoustical qualities, fire rating finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Accessibility Standard: As directed Fabricate doors to comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.
2. Single Pass Door: As directed 36 by 80 inches (914 by 2032 mm) or 36 by 84 inches (914 by 2134 mm).

3. Double Pass Door: As directed 72 by 80 inches (1829 by 2032 mm) or 72 by 84 inches (1829 by 2134 mm).
4. Pass-Door Hardware: Equip pass door with the following:

    a. Door Seals: As directed Mechanically operated floor seal on panels containing pass doors or Sweep floor seals.
    b. As directed Panic or Fire exit hardware.
    c. Concealed door closer.
    d. Door Viewer: Installed with view in direction of swing.
    e. Exit Sign: Recessed, self-illuminated.
    f. Latchset: Passage set.
    g. Lock: Key-operated lock with cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
    h. Lock: Deadlock to receive cylinder, operable from both sides of door. See As directed Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.
2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.
3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. As directed See Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

C. Windows: Manufacturer's standard or as indicated.

D. Work Surfaces: Quantities, placement, and size indicated.

1. Surface: Porcelain steel marker/projection surface, Self-healing, tackable, vinyl-coated fabric wall covering, complying with WA-101, Type II-Medium Duty; Class A; laminated to natural cork tackboard.
2. Surface Color: Matching Architect's sample or As selected by Architect from manufacturer's full range.

E. Chalk Tray and Eraser Pocket: Manufacturer's standard.

F. Chair Rails: Recessed or Surface mounted in locations indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

C. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

D. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.2 ADJUSTING

A. Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping.

B. Verify that safety devices are properly functioning.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102239

SECTION 102239.13 - FOLDING GLASS-PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manually operated, glass-panel partitions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. As directed.

C. Shop Drawings: For operable glass-panel partitions.

   1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
   2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

D. Samples: For each exposed product and for each color and texture specified.

E. Delegated-Design Submittal: For operable glass-panel partitions.

   1. Include design calculations for seismic restraints that brace tracks to structure above.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Seismic Qualification Certificates: For operable glass-panel partitions, tracks, accessories, and components, from manufacturer.

D. Product Certificates: For each type of operable glass-panel partition.

E. Product test reports.

F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable glass-panel partitions that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable glass-panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable glass-panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable glass-panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

D. Fire-Test-Response Characteristics: Provide wood-framed panels complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency.

a. Flame-Spread Index: As directed 25 or 75 or less.
b. Smoke-Developed Index: 450 or less.

2.2 OPERABLE GLASS PANELS

A. Operable Glass Panels: As directed Frameless aluminum, Aluminum-framed or Wood-framed glass-panel partition system, including panels, seals, suspension system, operators, and accessories.

B. Panel Operation: As directed Manually operated, individual, paired or continuously hinged panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 088000 "Glazing."

D. Glass and Glazing: Glass type as specified in Section 088000 "Glazing."

E. Glass and Glazing: As follows:

1. Glass: As directed Manufacturer's standard or Custom safety glass and glass assemblies as indicated and complying with the following requirements in Section 088000 "Glazing" and as follows:

a. Tempered Glass: As directed ASTM C1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear) or Class 2 (tinted), Quality-Q3.
b. Tempered Patterned Glass: ASTM C1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
c. Laminated Glass: As directed ASTM C1172, with clear, colored, patterned or graphic interlayer.

1) Annealed Float Glass: As directed ASTM C1036, Type I (transparent flat glass), Class 1 (clear) or Class 2 (tinted), Quality-Q3.
2) Patterned Glass: ASTM C1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.

d. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass as indicated, separated by a dehydrated interspace, qualified according to ASTM E2190, and complying with other requirements specified.

F. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

G. STC: As directed Not less than 36 or 44.

H. Panel Frame Materials:

1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; manufacturer's standard strengths and thicknesses for type of use.
2. Wood Frame: Clear, vertical-grain, straight, kiln-dried, fire-retardant-treated wood as follows:

    a. Species: Match Architect's sample, as selected by Architect from manufacturer's full range, Cherry, Hemlock, Maple, Meranti, Poplar or Red oak.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

J. Hardware: Manufacturer's standard as required to operate operable glass-panel partition and accessories; with decorative, protective finish.

K. Panel Frame Finishes:

1. Exposed Metal: Match Architect's sample or as selected by Architect from manufacturer's full range as follows:

    a. Aluminum: As directed Clear anodized, Light bronze anodized, Medium bronze anodized, Dark bronze anodized, Black anodized or Baked powder coating, black color.
    b. Metal-Clad Aluminum: As directed Satin stainless steel, Polished stainless steel, Satin brass, Polished brass, Satin bronze or Polished bronze.

2. Wood Finish: Match Architect's sample or as selected by Architect from manufacturer's full range, as follows:

    a. Type: As directed Transparent finish or Transparent finish over stain over wood variety indicated.

3. Wood Finish: As specified in Section 099300 "Staining and Transparent Finishing."

2.3 SEALS

A. Description: Seals that produce operable glass-panel partitions complying with performance requirements and the following:

1. Seals made from materials and in profiles that minimize sound leakage.
2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable glass-panel partition perimeter and adjacent surfaces, when operable glass-panel partition is extended and closed.

2.4 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous

system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable glass-panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

2.5 ACCESSORIES

A. Pass Doors: As directed Swinging door built into and matching panel materials, construction, acoustical qualities, finish and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Accessibility Standard: Fabricate doors to comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and or ICC A117.1.
2. Single Pass Door: As directed 36 by 80 inches (914 by 2032 mm) or 36 by 84 inches (914 by 2134 mm).
3. Double Pass Door: As directed 72 by 80 inches (1829 by 2032 mm) or 72 by 84 inches (1829 by 2134 mm).
4. Pass-Door Hardware: Equip pass door with the following:

    a. Door Seals: As directed Mechanically operated floor seal on panels containing pass doors or Sweep floor seals.
    b. Panic hardware.
    c. Concealed door closer.
    d. Latchset: Passage set.
    e. Lock: Key-operated lock with cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
    f. Lock: Deadlock to receive cylinder, operable from both sides of door. As directed See Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same frame material, finish, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.
2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.
3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinder and keying requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

C. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.2 ADJUSTING

A. Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping.

B. Verify that safety devices are properly functioning.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.

END OF SECTION 102239.13

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall guards.
2. Impact-resistant handrails.
3. Corner guards.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" As directed.
2. Section 057300 "Decorative Metal Railings" for metal handrails without plastic bumpers.
3. Section 064023 "Interior Architectural Woodwork for solid-wood handrails, bumper rails, chair rails, or corner moldings without plastic bumpers.
4. Section 087100 "Door Hardware" or Section 087111 "Door Hardware (Descriptive Specification)" as directed for metal and plastic protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details. Show handrail design and support spacing required to withstand structural loads.

D. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 as directed.

2.2 WALL GUARDS

A. Crash Rail: Heavy-duty, PVC-free assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.
1. Cover: Extruded rigid plastic, minimum 0.100-inch (2.5-mm) wall thickness; in dimensions and profiles indicated on Drawings.

a. Surface: As directed.
b. Color and Texture: As directed.

2. Continuous Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
3. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
4. Bumper: Continuous, resilient bumper cushion(s).
5. End Caps and Corners: Prefabricated, injection-molded plastic; matching color or contrasting with color cover as directed; field adjustable for close alignment with snap-on cover.
6. Accessories: Concealed splices and mounting hardware.
7. Mounting: As directed.

B. Bumper Rail: Standard-duty, PVC-free assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.

1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; in dimensions and profiles indicated on Drawings.

    a. Color and Texture: As directed.

2. Continuous Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Bumper: Continuous, resilient bumper cushion(s).
5. End Caps and Corners: Prefabricated, injection-molded plastic; matching color or contrasting with color cover as directed; field adjustable for close alignment with snap-on cover.
6. Accessories: Concealed splices and mounting hardware.
7. Mounting: As directed.

C. Rub Rail: Standard-duty, PVC-free assembly consisting of continuous snap-on cover installed over concealed, continuous retainer.
    1. Cover: Extruded plastic, minimum 0.078-inch (2.0-mm) wall thickness; in dimensions and profiles indicated on Drawings.

        a. Color and Texture: As directed.

    2. Retainer: Minimum 0.0625-inch- (1.6-mm-) thick, one-piece, extruded aluminum.
    3. End Caps and Corners: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
    4. Accessories: Concealed splices and mounting hardware.
    5. Mounting: Surface mounted directly to wall or Reveal mounted on bumper cushions as directed.

2.3 IMPACT-RESISTANT HANDRAILS

A. Structural Performance: Handrails, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

    1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    3. Uniform and concentrated loads need not be assumed to act concurrently.

B. Plastic, Impact-Resistant Handrails: Manufacturer's standard, PVC-free assembly consisting of snap-on plastic cover installed over continuous retainer.
    1. Cover: Minimum 0.078-inch- (2.0-mm-) or 0.100-inch- (2.5-mm-) as directed thick, extruded rigid plastic; in dimensions and profiles indicated on Drawings.

        a. Single Handrail: Cylindrical tube profile cover with continuous retainer; with mounting brackets supporting bottom of rail.
        b. Bumper Rail: Cover with flat or sculpted with contoured thumb recess on front side as directed; with 1-1/2-inch- (38-mm-) diameter gripping surface and finger recess on back side; supported by concealed, continuous retainer and extended mounting brackets.

1) Bumper Surface: As directed.

c. Color and Texture: As directed.

2. Retainer: Minimum 0.080-inch- (2.0-mm-) thick, one-piece, extruded aluminum.
3. Mounting Bracket: Extended mounting on injection-molded plastic or anodized-aluminum mounting brackets as directed.
4. End Caps and Corners: Prefabricated, injection-molded plastic; matching color or contrasting with color cover as directed; field adjustable for close alignment with snap-on cover.
5. Accessories: Concealed splices, cushions, and mounting hardware.

2.4 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) or 0.100-inch (2.5-mm) wall thickness as directed; in dimensions and profiles indicated on Drawings.

a. Color and Texture: As directed.

2. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum or One-piece extruded plastic as directed.
3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

B. Flush-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover that is flush with adjacent wall surface, installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) or 0.100-inch (2.5-mm) wall thickness as directed; in dimensions and profiles indicated on Drawings.

a. Color and Texture: As directed.

2. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Aluminum Cove Base: Nominal 4 inches (100 mm) or 6 inches (150 mm) high as directed.

C. Fire-Rated, Flush-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover that is flush with adjacent wall surface, installed over continuous retainer and intumescent fire barrier; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
1. Fire Rating: As directed; UL listed and labeled according to ASTM E1966 or UL 2079.

a. L-Rating at Smoke Barriers: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures according to UL 2079.

2. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) or 0.100-inch (2.5-mm) wall thickness as directed; in dimensions and profiles indicated on Drawings.

a. Color and Texture: As directed.

3. Retainer: Minimum 0.070-inch- (1.8-mm-) thick, one-piece, extruded aluminum.
4. Aluminum Cove Base: Nominal 4 inches (100 mm) or 6 inches (150 mm) high as directed.

D. Surface-Mounted, Opaque-Plastic Corner Guards: Fabricated as one piece as directed; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
1. Mounting: Countersunk screws through factory-drilled mounting holes or Adhesive as directed.
2. Color and Texture: As directed.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.

2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
3. Adjust end and top caps as required to ensure tight seams.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Private-use bathroom accessories.
4. Healthcare accessories.
5. Warm-air dryers.
6. Childcare accessories.
7. Underlavatory guards.
8. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full size, for each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser:
   1. Description: As directed Roll-in-reserve dispenser with hinged front secured with tumbler lockset, Single-roll dispenser, Double-roll dispenser or Double-roll dispenser with shelf.
   2. Mounting: As directed Recessed, Partition mounted, serving two adjacent toilet compartments or Surface mounted.
   3. Operation: As directed Noncontrol delivery with standard spindle, Noncontrol delivery with theft-resistant spindle, Spindleless with tension-spring controlled delivery, Spindleless with tension-spring controlled delivery and self-locking device extending through core that prevents core removal until roll is empty or Eccentric-shaped, molded-plastic spindle revolves one-half revolution per dispensing operation for controlled delivery; core cannot be removed until roll is empty.
   4. Capacity: As directed Designed for 4-1/2- or 5-inch- (114- or 127-mm-) or 5-inch- (127-mm-) diameter tissue rolls.
   5. Material and Finish: As directed Stainless steel, No. 4 finish (satin), Chrome-plated zinc alloy (zamac) or steel, Satin-finish aluminum bracket with plastic spindle or ABS plastic, gray.

B. Paper Towel (Folded) Dispenser:
   1. Mounting: As directed Recessed, Semirecessed, Deck mounted, recessed or Surface mounted.
   2. Minimum Capacity: As directed 400 C-fold or 525 multifold towels, 600 C-fold or 800 multifold towels or 400 single-fold towels.
   3. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.
   4. Lockset: Tumbler type.
   5. Refill Indicator: Pierced slots at sides or front.

C. Paper Towel (Roll) Dispenser:
   1. Description: Lever-actuated mechanism permitting controlled delivery of paper rolls in preset lengths per stroke.
   2. Mounting: As directed Recessed, Semirecessed or Surface mounted.
   3. Minimum Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll.
   4. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.
   5. Lockset: Tumbler type.

D. Automatic Paper Towel (Roll) Dispenser:
   1. Description: Automatic motion sensing mechanism with user-adjustable delay and paper towel length; battery powered.
   2. Mounting: As directed Recessed, Semirecessed or Surface mounted.
   3. Minimum Capacity: As directed 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll.
   4. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.

5. Lockset: Tumbler type.

E. Waste Receptacle:
1. Mounting: As directed Open top, recessed, Self-closing disposal-opening cover, recessed, Semirecessed, Surface mounted, Wall mounted for corner installation, Freestanding or Undercounter.
2. Minimum Capacity: As directed.
3. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Liner: Reusable vinyl liner.
5. Lockset: Tumbler type for waste receptacle.

F. Combination Towel (Folded) Dispenser/Waste Receptacle:
1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
2. Mounting: As directed Surface mounted, Surface mounted with stainless-steel collar, Recessed, Recessed with projecting receptacle or Semirecessed.

    a. Designed for nominal 4-inch (100-mm) or 6-inch (150-mm) wall depth.

3. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
4. Minimum Waste-Receptacle Capacity: As directed 4 gal. (15 L) or 12 gal. (45.4 L).
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

G. Combination Towel (Roll) Dispenser/Waste Receptacle:
1. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.
2. Mounting: As directed Recessed, Semirecessed or Surface mounted.
3. Minimum Towel-Dispenser Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll.
4. Minimum Waste Receptacle Capacity: As directed 8 gal. (30 L), 12 gal. (45.4 L) or 15 gal. (56.8 L).
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel dispenser compartment and waste receptacle.

H. Liquid-Soap Dispenser:

1. Description: As directed Designed for dispensing antibacterial soap in liquid or lotion or lather form.
2. Mounting: As directed, deck mounted on vanity, deck mounted on lavatory, horizontally oriented, recessed, horizontally oriented, surface mounted or vertically oriented, surface mounted.
3. Capacity: As directed.
4. Materials: As directed.
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

I. Automatic Liquid-Soap Dispenser:

1. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing antibacterial soap in liquid or lotion or lather form as directed.
2. Mounting: As directed Deck mounted on vanity or Deck mounted on lavatory.
3. Capacity: As directed.
4. Materials: As directed.
5. Refill Indicator: LED indicator.
6. Low Battery Indicator: LED indicator.

J. Grab Bar:
1. Mounting: As directed Flanges with concealed or exposed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: As directed 1-1/4 inches (32 mm) or 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings or Straight, 36 inches (914 mm) long.

K. Sanitary-Napkin Disposal Unit:
1. Mounting: As directed Recessed or Partition mounted, dual access or Surface mounted.
2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable.
4. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.

L. Seat-Cover Dispenser:
1. Mounting: As directed Surface mounted, Recessed or Partition mounted, dual access.
2. Minimum Capacity: As directed 250 or 500 seat covers.
3. Exposed Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.
4. Lockset: Tumbler type.

M. Mirror Unit:

1. Frame: As directed Stainless-steel angle, 0.05 inch (1.3 mm) thick, Stainless-steel channel, Stainless steel, fixed tilt or Stainless steel, adjustable tilt.

    a. Corners: As directed Manufacturer's standard, Mitered and mechanically interlocked or Welded and ground smooth.

2. Integral Shelf: 5 inches (127 mm) deep.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

N. Coat Hook:
1. Description: As directed Double or Single-prong unit.
2. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain Rod:

1. Description: As directed 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel or 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: Stainless steel, No. 4 finish (satin).

B. Shower Curtain:

1. Size: Minimum As directed 6 inches (152 mm) or 12 inches (305 mm) wider than opening by 72 inches (1828 mm) high.
2. Material: As directed Vinyl, minimum 0.006 inch (0.15 mm) thick, opaque, matte, Duck, minimum 8 oz. (227 g), white, 100 percent cotton or Nylon-reinforced vinyl, minimum 10 oz. (284 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial agent.
3. Color: As directed White, Green or As selected from manufacturer's full range.
4. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

C. Folding Shower Seat:
1. Configuration: As directed L-shaped seat, designed for wheelchair access, Rectangular seat, Triangular, corner-type seat or Stainless-steel seat designed to fold into recessed-mounted, stainless-steel wall box.
2. Seat: As directed Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect, White vinyl padded seat or Stainless steel, No. 4 finish (satin); 0.05-inch (1.3-mm) minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth.
3. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
4. Dimensions: As directed.

D. Robe Hook:
1. Description: As directed Double or Single-prong unit.
2. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

2.4 PRIVATE-USE BATHROOM ACCESSORIES

A. Toilet Tissue Dispenser:

1. Description: As directed Single-roll dispenser, Double-roll dispenser, Single-roll dispenser with hood or Double-roll dispenser with hood.
2. Mounting: As directed Recessed or Surface mounted.
3. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
4. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

B. Shower Curtain Rod:
1. Outside Diameter: As directed 1 inch (25.4 mm) or 1-1/4 inches (32 mm).
2. Mounting: As directed Flanges with exposed or concealed fasteners.
3. Rod Material and Finish: As directed Solid brass, polished, Polished chrome-plated brass, Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).
4. Flange Material and Finish: As directed Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).
5. Accessories: Integral chrome-plated brass glide hooks.

C. Soap Dish:
1. Description: As directed.
2. Mounting: As directed Recessed or Surface mounted.
3. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

D. Medicine Cabinet:
1. Mounting: As directed Recessed, for nominal 4-inch (100-mm) wall depth or Surface mounted.
2. Size: 18 by 24 inches (460 by 610 mm).
3. Door: Framed mirror door concealing storage cabinet equipped with continuous hinge and spring-buffered, rod-type stop and magnetic door catch.
4. Shelves: Three, adjustable.
5. Material and Finish:

    a. Cabinet: As directed Stainless steel, No. 4 finish (satin) or Steel with corrosion-resistant finish.
    b. Mirror Frame: As directed.
    c. Door: As directed.
    d. Hinge: As directed.
    e. Shelves: As directed.

E. Robe Hook As directed:
1. Description: As directed Double or Single-prong unit.
2. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

F. Toothbrush and Tumbler Holder:
1. Description: As directed.

2. Material and Finish: As directed Solid brass, polished, Polished brass-plated zinc alloy (zamac), Polished chrome-plated brass, Polished chrome-plated zinc alloy (zamac), Stainless steel, No. 4 finish (satin) or Stainless steel, No. 7 finish (polished).

G. Towel Bar:
1. Description: As directed 3/4-inch- (19-mm-) square tube with rectangular end brackets or 3/4-inch- (19-mm-) round tube with circular end brackets.
2. Mounting: As directed Flanges with concealed or exposed fasteners.
3. Length: As directed 18 inches (457 mm), 24 inches (610 mm) or 30 inches (762 mm).
4. Material and Finish: As directed Stainless steel, No. 4 finish (satin), Stainless steel, No. 7 finish (polished) or Polished aluminum.

H. Towel Shelf:
1. Description: As directed Surface-mounted, guest-towel shelf with four 3/8-inch- (9-mm-) diameter or 5/16-inch- (8-mm-) square stainless-steel tubes mounted in support arms.

a. Towel Bar: As directed 1/4-inch- (6-mm-) diameter or 5/16-inch- (8-mm-) square stainless-steel towel bar below shelf.

2. Length: As directed 18 inches (457 mm) or 24 inches (610 mm).
3. Material and Finish: As directed Polished brass-plated, stainless-steel, Polished chrome-plated, stainless-steel or Stainless steel, No. 7 finish (polished).

I. Towel Rack:
1. Description: Surface-mounted, guest-towel unit with approximately 1/4-inch- (6-mm-) diameter wire rings welded to upright wire bracket.
2. Capacity: As directed Two, Three or Four sets of bath towels, hand towels, and washcloths.
3. Nominal Height: As directed 11 inches (279 mm), 17 inches (432 mm) or 21 inches (533 mm).
4. Material and Finish: As directed Polished brass-plated zinc alloy (zamac) or Polished chrome-plated zinc alloy (zamac).

2.5 HEALTHCARE ACCESSORIES

A. Specimen Pass-Through Cabinet:
1. Description: With self-closing doors on both sides, lock that prevents doors from both being opened at same time, and removable stainless-steel tray.
2. Nominal Wall Opening: 12 by 11-1/4 inches (305 by 285 mm), width by height.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

B. Specimen Pass-Through Box:
1. Description: With minimum 12-inch- (305-mm-) diameter, turntable removable cylinder that revolves on stainless-steel, self-lubricating, ball-bearing plates, and with mechanism to prevent over rotation of cylinder.
2. Nominal Wall Opening: 13-1/4 by 14 inches (335 by 355 mm), width by height.
3. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Lockset: Tumbler type.

C. Bedpan and Urinal Cabinet:
1. Description: For storing one conventional-size bedpan and one urinal bottle; with door that produces 1/2-inch (13-mm) opening at top and bottom of cabinet to allow air circulation.
2. Mounting: Recessed.
3. Nominal Wall Opening: 13-1/2 by 26-1/2 by 5 inches (340 by 670 by 130 mm), width by height by depth.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Bedpan and Urinal Rack:
1. Description: For storing one conventional-size bedpan and one urinal bottle.
2. Mounting: Surface mounted.
3. Size: 12 by 27 inches (300 by 685 mm), width by height.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.6 WARM-AIR DRYERS

A. Warm-Air Dryer:
1. Description: Standard-speed, warm-air hand dryer.
2. Mounting: As directed Recessed, Semirecessed, Surface mounted, with low-profile design.
3. Operation: As directed Touch-button or Electronic-sensor activated with timed power cut-off switch.

a. Operation Time: As directed 30 to 40 or 80 seconds.

4. Cover Material and Finish: As directed Steel, with white enamel finish, Cast iron, with enamel finish in color selected by Architect, Chrome-plated steel, Stainless steel, No. 4 finish (satin), Molded plastic, gray or Molded plastic, white.
5. Electrical Requirements: As directed 115 V, 13 A, 1500 W, 115 V, 15 A, 1725 W, 115 V, 20 A, 2300 W or 208-240 V, 9-10 A, 1900-2300 W.

B. High-Speed Warm-Air Dryer:
1. Description: High-speed, warm-air hand dryer for rapid hand drying.
2. Mounting: As directed Recessed, Semirecessed, Surface mounted, with low-profile design.
3. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.
4. Cover Material and Finish: As directed Steel, with white enamel finish, Cast iron, with enamel finish in color selected by Architect, Chrome-plated steel, Stainless steel, No. 4 finish (satin), Molded plastic, gray or Molded plastic, white.
5. Electrical Requirements: As directed 115 V, 13 A, 1500 W, 115 V, 15 A, 1725 W, 115 V, 20 A, 2300 W or 208-240 V, 9-10 A, 1900-2300 W.

C. Multiple Airflow Warm-Air Dryer:
1. Description: Multiple airflow warm-air hand dryer, using two or more airstreams for rapid hand drying.
2. Mounting: As directed Recessed, Semirecessed, Surface mounted, with low-profile design.
3. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.

4. Cover Material and Finish: As directed Steel, with white enamel finish, Cast iron, with enamel finish in color selected by Architect, Chrome-plated steel, Stainless steel, No. 4 finish (satin), Molded plastic, gray or Molded plastic, white.
5. Electrical Requirements: As directed 115 V, 13 A, 1500 W, 115 V, 15 A, 1725 W, 115 V, 20 A, 2300 W or 208-240 V, 9-10 A, 1900-2300 W.

2.7 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:
1. Description: As directed Horizontal or Vertical unit that opens by folding down from stored position and with child-protection strap.

    a. Engineered to support minimum of 250-lb (113-kg) static load when opened.

2. Mounting: As directed Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed or Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: As directed HDPE in manufacturer's standard color, HDPE with plastic-laminate insert in color selected by Architect, Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners or Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color.
5. Liner Dispenser: Built in.

2.8 UNDERLAVATORY GUARDS

A. Underlavatory Guard:
1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.9 CUSTODIAL ACCESSORIES

A. Utility Shelf:
1. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
2. Size: 16 inches (406 mm) long by 6 inches (152 mm) deep.
3. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).

B. Mop and Broom Holder:
1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches (914 mm).
3. Hooks: Four.
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

C. Paper Towel (Folded) Dispenser:
1. Mounting: As directed Recessed, Semirecessed or Surface mounted.
2. Minimum Capacity: As directed 400 C-fold or 525 multifold towels, 600 C-fold or 800 multifold towels or 400 single-fold towels.
3. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.
4. Lockset: Tumbler type.
5. Refill Indicator: Pierced slots at sides or front.

D. Paper Towel (Roll) Dispenser:
1. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
2. Mounting: As directed Recessed, Semirecessed or Surface mounted.
3. Minimum Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll.
4. Material and Finish: As directed Stainless steel, No. 4 finish (satin) or ABS plastic, gray.
5. Lockset: Tumbler type.

E. Liquid-Soap Dispenser:
1. Description: As directed Designed for dispensing soap in liquid or lotion or lather form.
2. Mounting: As directed Deck mounted on vanity, Deck mounted on lavatory, Horizontally oriented, recessed, Horizontally oriented, surface mounted or Vertically oriented, surface mounted.
3. Capacity: As directed.
4. Materials: As directed.
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

2.10 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install unit level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

END OF SECTION 102800

SECTION 102813.63 - DETENTION TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Safety hooks.
2. Shelves.
3. Miscellaneous toilet accessories.
4. Stainless-steel mirrors.
5. Grab bars.
6. Shower seats.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for nondetention toilet accessories.

1.2 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by a Detention Specialist or other entity.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference as directed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Samples: For each detention toilet accessory indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Location of each built-in anchor supporting detention toilet accessories, including anchors to be installed as work of other Sections, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Anchor inspection reports.

C. Field quality-control certification signed by Contractor and Detention Specialist.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace detention toilet accessories that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DETENTION SAFETY HOOKS

A. Individual, Curved, Detention Safety Hook: 0.188-inch (4.77-m) nominal-thickness, stainless-steel curved hook held by 0.141-inch- (3.58-mm) or 0.109-inch (2.77-mm) thick, stainless-steel bracket punched with not less than two holes for fastening with security fastener as directed. Provide friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit indicated in Part 3.

B. Individual, Straight, Detention Safety Hook: 3/8-inch (9.5-mm) or 1/4-inch (6.3-mm) diameter, stainless-steel straight hook as directed held by 0.109-inch (2.77-mm) or 0.078-inch (1.98-mm) thick, stainless-steel mounting plate approximately 4 inches (102 mm) square as directed. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds as directed.
1. Mounting: Front mounting with security fasteners or Chase mounting with welded anchor nuts on backplate as directed.

C. Multiple, Curved, Safety Hook Strip: Minimum 5-1/2-inch (140-mm) high backplate by length indicated, formed thick, stainless-steel sheet as directed. Provide 0.188-inch (4.77-mm) thick, stainless-steel hooks attached to backplate; with each hook having a friction washer assembly, adjustable with a nonremovable security screw that maintains pressure on hook and allows hook to pivot when load exceeds preset limit indicated in Part 3.
1. Configuration: As directed.
2. Mounting: Front mounting with security fasteners or Chase mounting with welded anchor nuts on backplate as directed.

D. Multiple, Straight, Safety Hook Strip: Minimum 5-1/2-inch (140-mm) high backplate by length indicated, formed from thick, stainless-steel sheet as directed. Provide 3/8-inch (9.5-mm) or 1/4-inch (6.3-mm) diameter, stainless-steel straight hooks attached as directed to backplate. Provide pivoting assembly that maintains pressure on hook and snaps down when load exceeds as directed.
1. Configuration: As directed.

2. Mounting: Front mounting with security fasteners or Chase mounting with welded anchor nuts on backplate as directed.

E. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

F. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: No. 4.

2.2 DETENTION SHELVES

A. Surface-Mounted, Steel Detention Shelf: Minimum 6 inches high by 8 inches (152 mm high by 203 mm) deep as directed long; formed as directed from nominal-thickness, metallic-coated steel sheet; with welded side gussets and minimum 1-inch (25.4-mm) flanged front edge; with back punched for fastening to wall with security fasteners.

B. Surface-Mounted, Stainless-Steel Detention Shelf: Minimum 5-1/2 inches high by 8 inches (140 mm high by 203 mm) deep by 18 inches (457 mm) or 24 inches (610 mm) long as directed; formed from 0.078-inch (1.98-mm) thick, stainless-steel sheet; with welded side gussets and hemmed front edge.

1. Mounting: Front mounting with security fasteners or Chase mounting with welded anchor nuts on backplate as directed.

C. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) coating designation.

D. Finishes:

1. Metallic-Coated Steel Sheet Finish:

a. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical

connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

b. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.

c. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1) Color and Gloss: As directed.

2. Stainless-Steel Finish:

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

b. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3) Directional Satin Finish: No. 4.

2.3 MISCELLANEOUS DETENTION TOILET ACCESSORIES

A. Recessed, Detention Toilet Tissue Holder: Minimum 5-inch diameter by 4-1/2 inches (127-mm diameter by 114 mm) deep; formed from 0.062-inch (1.57-mm) thick, stainless-steel sheet. Secure to wall with rear-mounting steel strap and adjustment bolts.

1. Face: 1-inch (25.4-mm) lip around entire face or 7-inch (178-mm) square face flange as directed.

B. Recessed, Detention Soap Dish: Minimum inside dimensions of 5-3/4 inches wide by 4-1/2 inches high by 2-1/2 inches (146 mm wide by 114 mm high by 64 mm) deep with 3/4-inch (19-mm) lip around entire face; formed from 0.062-inch (1.57-mm) or 0.050-inch (1.27-mm) thick, stainless-steel sheet as directed. Secure to wall with rear-mounting steel strap and adjustment bolts.

C. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

D. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.

b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: No. 4.

2.4 DETENTION MIRRORS

A. Small, Integrally Framed Detention Mirror: Mirror and integral frame formed from a single sheet of 0.038-inch (0.95-mm) or 0.062-inch (1.57-mm) thick, stainless steel; with round corners as directed.
1. Size: Approximately 9-1/2 by 11 inches (241 by 279 mm).
2. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate or Chase mounting with welded anchor nuts on backplate as directed.

B. Large, Framed Detention Mirror with Round Corners: Formed from a single sheet of 0.038-inch (0.95-mm) or 0.078-inch (1.98-mm) thick, stainless steel as directed; enclosed in a metal frame.
1. Size: Minimum 12 by 16 inches (305 by 406 mm).
2. Frame: Formed from 0.064-inch (1.63-mm) nominal-thickness, chrome-plated steel or 0.078-inch (1.98-mm) thick, stainless-steel sheet as directed. Fabricate frame with welded and ground corners or from one piece of metal.
3. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate or Chase mounting with welded anchor nuts on backplate as directed.

C. Large, Integrally Framed Detention Mirror with Round Corners: Mirror and integral frame formed from thick, stainless-steel sheet; with round corners as directed.
1. Size: Minimum 12 by 16 inches (305 by 406 mm).
2. Mounting: Front mounting with security fasteners to 0.168-inch (4.27-mm) nominal-thickness, metallic-coated steel mounting plate or Chase mounting with welded anchor nuts on backplate as directed.

D. Materials:

1. Metallic-Coated Steel Sheet: ASTM A653/A653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) coating designation.
2. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

E. Finishes:

1. Metallic-Coated Steel Sheet Finish:

a. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.
b. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the coating to be applied over it.

c. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1) Color and Gloss: As directed.

2. Stainless-Steel Finish:

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2) Mirrorlike Reflective, Nondirectional Polish: No. 8.

3. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

2.5 DETENTION GRAB BARS

A. Grab Bars: 1-1/2 inches (38.1 mm) in diameter; formed from 0.038-inch (0.95-mm) thick, stainless-steel tubing, with 3-inch (76.2-mm) diameter flanges formed from 0.125-inch (3.18-mm) thick, stainless steel. Closure plates formed from 0.125-inch (3.18-mm) thick, stainless steel. All-welded construction.
1. Length: 36 inches (914 mm) long.
2. Mounting: Front mounting with security fasteners or Chase mounting with welded anchor nuts on backplate as directed.

B. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.
2. Stainless-Steel Tubing: ASTM A1016/A1016M, austenitic stainless steel, Type 304, seamless.

C. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: No. 4.

2.6 DETENTION SHOWER SEATS

A. Shower Seats: Double-pan retractable, recessed shower seat with recessed handle. Approximately 16- by 16-inch (406- by 406-mm) overall size formed from 0.062-inch- (1.57-mm-) or 0.078-inch- (1.98-mm-) thick, stainless-steel sheet as directed. Seat pivots on solid 0.375-inch- (9.5-mm-) diameter stainless-steel rod and self-latches when closed. Minimum 750-lb (340-kg) loading capacity.

B. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

C. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
    c. Directional Satin Finish: No. 4.

2.7 FABRICATION

A. Coordinate dimensions and attachment methods of detention toilet accessories with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Form edges and corners to be free of sharp edges and rough areas. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch (12.7-mm) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (0.8 mm) and support with concealed stiffeners.

D. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld corners and seams continuously to comply with referenced AWS standard.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention toilet accessories rigidly in place and to support expected loads.

G. Cut, reinforce, drill, and tap detention toilet accessories to receive hardware, security fasteners, and similar items.

H. Form exposed work true to line and level with accurate angles and surfaces. Grind off and ease edges unless otherwise indicated.

I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

2.8 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener.
   1. Drive-System Type: Pinned Torx-Plus or Pinned Torx as directed.

2.9 SECURITY SEALANTS

A. Polyurethane Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement.

B. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.

2.10 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below:

   1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.

C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16-inch (4.8 mm) thick; with minimum 1/2-inch (12.7-mm) diameter, headed studs welded to back of plate.

D. Proprietary Built-in Masonry Anchors: Fabricated as directed into 6-inch (152-mm) or 8-inch (203-mm) deep blocks as directed matching size of concrete masonry units; with weld nuts attached on inside to receive field-bolted attachments.
   1. Finish: As directed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect built-in and cast-in anchor installations before installing detention toilet accessories to verify that anchor installations comply with requirements. Prepare inspection reports.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention toilet accessories to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

C. Provide temporary bracing or anchors in formwork for items that are to be built into construction.

D. Apply polyurethane or epoxy security sealant as directed around perimeter in a continuous ribbon on back of detention toilet accessories before installation.

E. Security Fasteners: Install detention toilet accessories using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials.

F. Grab Bars: Install to withstand a downward load of not less than 250 lbf (1112 N) per ASTM F446.

3.2 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Prepare field quality-control certification endorsed by Detention Specialist that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION 102813.63

SECTION 102819 - TUB AND SHOWER ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes framed shower doors and enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For tub and shower doors and enclosures.

D. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tub and shower doors and enclosures that fail in materials or workmanship within specified warranty period, without monetary limitation.

1. Warranty Period: As directed Two or Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FRAMED ENCLOSURES

A. Glass panels with full perimeter frames of extruded aluminum with screw-fastened corners. Minimum 3/8-inch (10-mm) penetration of glass into frame. Framing members of thickness required to support imposed loads.

B. Frames, Hardware, and Trim: Manufacturer's standard units as indicated and as required for a complete installation.

1. Materials: Aluminum; ASTM B221 (ASTM B221M).
2. Finish: As directed Clear anodic, Color anodic or Baked enamel or powder coat.
3. Color: As directed Silver, Gold or Black.

C. Bypassing Doors: Sliding units suspended from top track by fully adjustable ball-bearing rollers. Self-draining sill tracks with nylon panel guides. Molded jamb bumpers with concealed fasteners.

1. Door Pulls: Full-door-width, single-sided towel bars.

D. Swinging Doors: As directed Full-height piano hinge or Top-and-bottom pivot hinges. Manufacturer's standard pulls and latch.

E. Glazing: Comply with requirements in Section 088000 "Glazing."

F. Glazing: Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.

1. Glass Nominal Thickness: As directed 6 or 10 mm.
2. Patterned Glass: ASTM C1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F1 (patterned, one side).

a. Pattern: As directed Manufacturer's standard or Pattern P3 (random).

G. Fasteners: Manufacturer's standard stainless-steel or other noncorrosive fasteners.

H. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, for Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare and install per manufacturer's written instructions unless more stringent requirements are contained in GANA's "Glazing Manual."

B. Clean substrates, removing projections, filling voids, and sealing joints.

C. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.

D. Fasten components securely in place, with provisions for thermal movement. Install with concealed fasteners unless otherwise indicated.

E. Install components to drain and return water to tub or shower.

F. Install doors to produce smooth operation and tight fit at contact points.

G. Repair, refinish, or replace components damaged during installation.

3.2 ADJUSTING AND CLEANING

A. Adjust operating parts and hardware for smooth, quiet operation and watertight closure. Lubricate hardware and moving parts.

B. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 102819

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-protection cabinets.

C. Samples: For each type of exposed finish required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

B. Cabinet Construction: As directed.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch (1.09-mm) thick cold-rolled steel sheet lined with minimum 5/8-inch (16-mm) thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: As directed.

D. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as plaster stop or drywall bead as directed.
2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
2. Rolled-Edge Trim: Backbend depth as directed

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: As directed.

H. Door Material: As directed.

I. Door Style: As directed.

J. Door Glazing: As directed.

1. Acrylic Sheet Color: Clear or Bronze as directed transparent acrylic sheet.
2. Acrylic Sheet Color: Clear transparent acrylic sheet painted on unexposed side as directed.
3. Acrylic Bubble Color: Transparent or as directed.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Break-Glass Door Handle: Manufacturer's standard, integral to glass with the words "PULL TO BREAK GLASS" applied to handle.
4. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
5. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle or Cylinder lock, keyed alike to other cabinets as directed.
6. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet door or cabinet glazing as directed.
        2) Application Process: As directed.
        3) Lettering Color: As directed.
        4) Orientation: Vertical or Horizontal as directed.

7. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries or low voltage, complete with transformer as directed.

M. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: As directed.
    b. Color: As directed.

2. Aluminum: ASTM B221 (ASTM B221M) for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

    a. Finish: As directed.
    b. Color: As directed.

3. Stainless Steel: ASTM A666, Type 304.

    a. Finish: No. 4 directional satin finish or No. 8 mirrorlike reflective, nondirectional polish as directed.

4. Copper Alloy, Brass: ASTM B36/B36M alloy as standard with manufacturer.

    a. Finish: Polished or Satin as directed.

5. Copper Alloy, Bronze: ASTM B36/B36M alloy as directed

    a. Finish: As directed.

6. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 3 or 6 mm thick as directed.

7. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) or Class 2 (tinted, heat absorbing, and light reducing), bronze tint as directed.
8. Break Glass: Clear annealed float glass, ASTM C1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
9. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
10. Wire Glass: ASTM C1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
11. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), mm thick as directed, with Finish 1 (smooth or polished) or Finish 2 (patterned, textured) as directed.

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for recessed and semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply decals or vinyl lettering at locations indicated as directed.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
   1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Stored-Pressure Water Type: UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.

C. Stored-Pressure Antifreeze Water Type: UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F (minus 40 deg C) in stainless-steel container; with pressure-indicating gage.

D. Stored-Pressure Water-Mist Type: UL-rated 2-A:C, 2.5-gal. (9.5-L) nominal capacity, with water in enameled-steel container; with pressure-indicating gage.

E. Regular Dry-Chemical Type: As directed UL-rated nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

F. Multipurpose Dry-Chemical Type: As directed UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

G. Carbon Dioxide Type: As directed UL-rated 5-B:C, 5-lb (2.3-kg), 10-B:C, 10-lb (4.5-kg), 10-B:C, 15-lb (6.8-kg) or 10-B:C, 20-lb (9.1-kg) nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

H. Clean-Agent Type in Steel Container: As directed UL-rated 5-B:C, 4.75-lb (2.2-kg), 1-A:10-B:C, 10-lb (4.5-kg) or 2-A:10-B:C, 14-lb (6.4-kg) nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: As directed Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red or black baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: As directed Vertical or Horizontal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 104513 - PHOTOLUMINESCENT EGRESS PATH MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes photoluminescent egress path markings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For photoluminescent egress path markings.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace photoluminescent egress path markings that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Luminance: Comply with one of the following; testing by a qualified testing agency:

1. UL 1994.
2. ASTM E2072; except that the charging source shall be 1 foot-candle (11 lux) of fluorescent illumination for 60 min., and the minimum luminance shall be 30 millicandelas/sq. m after 10 min. and 5 millicandelas/sq. m after 90 min.

2.2 PHOTOLUMINESCENT EGRESS PATH MARKINGS

A. Photoluminescent Egress Path Markings: Photoluminescent products containing no radioactive materials and requiring no electrical power.

B. Stair-and-Landing Nosing Markings: As directed Slip-resistive self-adhesive tape stripes; 1 inch (25 mm) or 2 inches (51 mm) wide.

C. Handrail Markings: As directed Self-adhesive tape or semi-rigid stripes; 1 inch (25 mm) or 2 inches (51 mm) wide.

D. Floor-Mounted Perimeter Markings: As directed Self-adhesive tape stripes; 1 inch (25 mm) or 2 inches (51 mm) wide; with directional arrows.

E. Wall-Mounted Perimeter Markings: As directed Self-adhesive tape stripes; 1 inch (25 mm) or 2 inches (51 mm) wide; with directional arrows.

F. Obstacle Marking: Self-adhesive stripe with alternating diagonal bands of black and photoluminescent material.

G. Door Frame Markings: As directed Self-adhesive tape stripes 1 inch (25 mm) or 2 inches (51 mm) wide; with directional arrows.

H. Door Hardware Markings: As directed Square self-adhesive sticker or rigid plastic, 4 inches by 4 inches (102 mm by 102 mm).

I. Exit Signs: Rigid plastic or aluminum sign for low-level mounting, with emergency exit symbol complying with NFPA 170; with self-adhesive backing; with a minimum height of 4 inches (102 mm); and with running man symbol facing right or left to suit installation condition.

J. Adhesive: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install photoluminescent egress path markings according to manufacturer's written instructions.

END OF SECTION 104513

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knocked-down corridor lockers.
2. Welded corridor lockers.
3. Knocked-down athletic lockers.
4. Welded athletic lockers.
5. Locker benches.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. As directed.

C. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Include locker identification system and numbering sequence.

D. Samples: For each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.
2. Warranty Period for Welded Metal Lockers: As directed Lifetime or 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 KNOCKED-DOWN CORRIDOR LOCKERS

A. Doors: As directed One piece; fabricated from 0.060-inch (1.52-mm) or 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches (305 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches (381 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
5. Door Style: As directed Unperforated panel. Vented panel as follows:

    a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier, three louver openings at top and bottom for double-tier or two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier lockers.
    b. Perforated Vents: Manufacturer's standard shape and configuration.
    c. Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.

B. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.

C. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into

vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

D. Hinges:

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
2. Continuous Hinges: Manufacturer's standard, steel, full height.
3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

E. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.

1. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.

    a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
    b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

2. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock, with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

    a. Latch Hook: Equip each door with one latch hook.

G. As directed Door Handle and Latch for Box or 16-Person Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

H. Locks: As directed Combination padlocks, Built-in combination locks, Cylinder locks, Built-in, card-operated locks or Digital keypad locks or Built-in, coin-operated locks.

I. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

J. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

K. Coat Rods: Manufacturer's standard.

L. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

M. Continuous Zee Base: As directed Fabricated from 0.060-inch (1.52-mm), 0.075-inch (1.90-mm) or manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.

1. Height: 4 inches (102 mm).

N. Continuous Sloping Tops: As directed Fabricated from 0.036-inch (0.91-mm), 0.048-inch (1.21-mm) or manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm) nominal-thickness steel sheet.

1. Closures: As directed Vertical or Hipped-end type.

O. Individual Sloping Tops: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

P. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

Q. Filler Panels: As directed Fabricated from 0.036-inch (0.91-mm), 0.048-inch (1.21-mm) or manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm) nominal-thickness steel sheet.

R. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

S. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

T. Center Dividers: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

U. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

V. Finish: Baked enamel or powder coat.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

2.3 WELDED CORRIDOR LOCKERS

A. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
2. Door Style: As directed Unperforated panel. Vented panel as follows:

    a. Louvered Vents: As directed No fewer than six louver openings at top and bottom for single-tier, three louver openings at top and bottom for double-tier or two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier lockers.
    b. Perforated Vents: Manufacturer's standard shape and configuration.

B. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

C. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

D. Hinges:

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
2. Continuous Hinges: Manufacturer's standard, steel, full height.
3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

E. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.

1. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

2. Single-Point Latching: As directed Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock or with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

a. Latch Hook: Equip each door with one latch hook.

G. Door Handle and Latch for Box or 16-Person Lockers As directed: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

H. Locks: As directed Combination padlocks, Built-in combination locks, Cylinder locks, Built-in, card-operated locks, Digital keypad locks or Built-in, coin-operated locks.

I. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

J. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

K. Coat Rods: Manufacturer's standard.

L. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

M. Continuous Zee Base: As directed Fabricated from, 0.060-inch (1.52-mm), 0.075-inch (1.90-mm) or manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.

1. Height: 4 inches (102 mm).

N. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: As directed Vertical or Hipped-end type.

O. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

P. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

Q. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

R. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

S. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

T. Finish: Baked enamel or powder coat.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.4 KNOCKED-DOWN ATHLETIC LOCKERS

A. Perforated Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

B. Expanded-Metal Doors: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angle frame; with 0.090-inch (2.28-mm) nominal-thickness, steel sheet lock panel backed by 0.060-inch (1.52-mm) nominal-thickness, steel sheet retainer welded to door frame.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: As directed Fabricated from 0.048-inch (1.21-mm) or 0.060-inch (1.52-mm) nominal-thickness steel sheet.

E. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations.

F. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.

G. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.097-inch (2.45-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

H. Reinforced Bottoms: As directed Structural channels, formed from 0.060-inch (1.52-mm) or 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.

I. Hinges:

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

J. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.

    a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
    b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

2. Single-Point Latching: As directed Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock or with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

    a. Latch Hook: Equip each door with one latch hook.

K. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.

L. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

M. Locks: As directed Combination padlocks, Built-in combination locks, Cylinder locks, Built-in, card-operated locks, Digital keypad locks or Built-in, coin-operated locks.

N. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

O. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

P. Coat Rods: Manufacturer's standard.

Q. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

R. Continuous Zee Base: 4 inches (102 mm) high; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.

S. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: As directed Vertical or Hipped-end type.

T. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

U. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

V. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

W. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

X. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.

Y. Finish: Baked enamel or powder coat.

1. Color: As directed As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.5 WELDED ATHLETIC LOCKERS

A. Perforated Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

B. Expanded-Metal Doors: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angle frame; with 0.090-inch

(2.28-mm) nominal-thickness, steel sheet lock panel backed by 0.060-inch (1.52-mm) nominal-thickness, steel sheet retainer welded to door frame.

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.060-inch (1.52-mm) nominal thickness, with single bend at edges.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Unperforated Sides: As directed Fabricated from 0.048-inch (1.21-mm) or 0.060-inch (1.52-mm) nominal-thickness steel sheet.

E. Perforated Sides: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet with manufacturer's standard diamond perforations.

F. Expanded-Metal Sides: Fabricated from 0.090-inch (2.28-mm) nominal-thickness expanded metal; welded to 0.105-inch (2.66-mm) nominal-thickness steel angles or 0.060-inch (1.52-mm) nominal-thickness steel channel frames.

G. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet or 0.097-inch (2.45-mm) nominal-thickness steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

H. Reinforced Bottoms: As directed Structural channels, formed from 0.060-inch (1.52-mm) or 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to front and rear of side-panel frames.

I. Hinges:

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches (51 mm) high. Provide no fewer than three hinges for each door more than 42 inches (1067 mm) high.
2. Continuous Hinges: Manufacturer's standard, steel; side or top mounted as required by locker configuration.
3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

J. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in cylinder locks, or padlocks; positive automatic latching and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.
b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism.

2. Single-Point Latching: As directed Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock or with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

    a. Latch Hook: Equip each door with one latch hook.

K. Projecting Turn-Handle and Latch: Steel handle welded to manufacturer's standard, three-point, cremone-type latching mechanism consisting of steel rods or bars that engage locker frame at top and bottom of door, and center latch that engages strike jamb; with steel padlock loop.

L. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

M. Locks: As directed Combination padlocks, Built-in combination locks, Cylinder locks, Built-in, card-operated locks, Digital keypad locks or Built-in, coin-operated locks.

N. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

O. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

P. Coat Rods: Manufacturer's standard.

Q. Legs: 6 inches (152 mm) high; formed by extending vertical frame members, or fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

R. Continuous Zee Base: 4 inches (102 mm) high; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.

S. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: As directed Vertical or Hipped-end type.

T. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

U. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

V. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

W. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

X. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

3. Expanded Metal: ASTM F1267, Type II (flattened), Class I (uncoated), 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.

Y. Finish: Baked enamel or powder coat.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.6 LOCKS

A. Combination Padlock: As directed Key-controlled, three-number dialing combination locks; capable of five combination changes or Provided by Owner.

B. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

C. Cylinder Lock: Built-in, flush, cam lock with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.

1. Key Type: As directed Flat or Grooved, with minimum 2- by 2.68-inch (51- by 68.3-mm) key head for accessible lockers.
2. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

D. Built-in, Card-Operated Lock: Self-contained units mounted on interior of door with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change card key for each lock and one master card key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

E. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.

1. Designed for permanently assigned access via entry of user's four-digit code.
2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

2.7 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick) except provide 20- to 24-inch- (508- to 610-mm-) wide tops where accessible benches are indicated.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.

1. Color: As directed Match metal lockers, as indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

D. Movable-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top, complete with fasteners, and as follows:

1. Finish: As directed Manufacturer's standard or No. 4B.

E. Materials:

1. Stainless Steel: ASTM A666, Type 304.
2. Steel Tube: ASTM A500/A500M, cold rolled.

2.8 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.
4. Coat Rods: As indicated on Drawings, for each compartment of each locker, In lieu of ceiling hook for metal lockers 24 inches (610 mm) high or more or In lieu of ceiling hook for metal lockers 18 inches (457 mm) deep or more.

D. Knocked-Down Construction: As directed Fabricate metal lockers by assembling at Project site or preassembling at plant prior to shipping, using manufacturer's nuts, bolts, screws, or rivets.

E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

F. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

G. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

J. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

L. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of non-recessed metal lockers; finished to match lockers.

M. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of non-recessed metal lockers; finished to match lockers.

N. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers or of lockers and to floor.
3. Anchor back-to-back metal lockers to floor.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach boxed end panels using concealed fasteners to conceal exposed ends of non-recessed metal lockers.

5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of non-recessed metal lockers.

E. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart.

END OF SECTION 105113

SECTION 105113.13 - COIN-OPERATED METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel, coin-operated lockers.
2. Stainless-steel, coin-operated lockers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. As directed.

C. Shop Drawings: For coin-operated lockers.

1. Include plans, elevations, sections, and attachment details.
2. Include locker identification system and numbering sequence.

D. Samples: For each color specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For coin-operated lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 STEEL, COIN-OPERATED LOCKERS

A. Coin-Operated Lockers: Fabricated from steel sheet with thicknesses as follows:

1. Tops, Bottoms, Sides, and Shelves: 0.024-inch (0.61-mm) nominal thickness.
2. Backs: 0.036-inch (0.91-mm) nominal thickness.
3. Frames: 0.060-inch (1.52-mm) nominal thickness.
4. Doors: 0.060-inch (1.52-mm) nominal thickness.
5. Exposed Ends of Nonrecessed Lockers: 0.060-inch (1.52-mm) nominal thickness.

B. Body: Assembled by welding or riveting body components to frames; flanged for double thickness at back vertical corners; back ventilated.

C. Frames: Channel formed; lapped and welded at corners; with top, bottom, and cross frames welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames, and equip frames with resilient bumpers to cushion door closing.

D. Doors: One piece; formed into channel shape at vertical edges and flanged at right angles at horizontal edges; fabricated to swing 180 degrees. Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.

E. Hinges: Manufacturer's standard, full-loop, five- or seven-knuckle type; tight pin; minimum 2-1/2 inches (64 mm) high or continuous type, of same material as door; self-closing. Weld hinge to inside of door frame and attach hinge to door with factory-installed fasteners that are completely concealed and tamper resistant when door is closed.

F. Projecting Door Handle: Manufacturer's standard; stainless steel; pry and vandal resistant.

G. Built-in, Coin-Operated Locks: Self-contained units mounted on door interior with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change key for each lock and one master key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.
2. Lock Type: As directed Fee return/deposit or collect/pay.
3. Fee Type: As directed Token, Coin, one quarter or Coin, two quarters.
4. Coin Box: Furnish with removable cylinder and key, and master code changer key.

H. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

I. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

J. Continuous Zee Base: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

1. Height: 4 inches (102 mm).

K. As directed Continuous or Individual Sloping Tops: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.

L. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

M. Filler Panels: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.

N. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

O. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

P. Finish: Baked enamel or powder coat.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

2.3 STAINLESS-STEEL, COIN-OPERATED LOCKERS

A. Stainless-Steel Lockers: Fabricated from stainless-steel sheet with thicknesses as follows:

1. Tops, Bottoms, Sides, Backs, and Shelves: 0.025 inch (0.64 mm) thick.
2. Frames: 0.062 inch (1.59 mm) thick.
3. Doors: 0.062 inch (1.59 mm) thick.
4. Exposed Ends of Non-recessed Lockers: 0.062 inch (1.59 mm) thick.

B. Body: Assembled by welding or riveting body components to frames; flanged for double thickness at back vertical corners; back ventilated.

C. Frames: Channel formed; lapped and welded at corners; with top, bottom, and cross frames welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames, and equip frames with resilient bumpers to cushion door closing.

D. Doors: One piece; formed into channel shape at vertical edges and flanged at right angles at horizontal edges; fabricated to swing 180 degrees. Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.

E. Hinges: Manufacturer's standard, full-loop, five- or seven-knuckle type; tight pin; minimum 2-1/2 inches (64 mm) high or continuous type, of same material as door; self-closing. Weld hinge to inside of door frame and attach hinge to door with factory-installed fasteners that are completely concealed and tamper resistant when door is closed.

F. Projecting Door Handle: Manufacturer's standard; stainless steel; pry and vandal resistant.

G. Built-in, Coin-Operated Locks: Self-contained units mounted on door interior with replaceable lock cylinders keyed separately and master keyed. Mount instruction decals on both door faces. Furnish one change key for each lock and one master key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.
2. Lock Type: As directed Fee return/deposit or collect/pay.
3. Fee Type: As directed Token, Coin, one quarter or Coin, two quarters.
4. Coin Box: Furnish with removable cylinder and key, and master code changer key.

H. Identification Plates: As directed Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch (9 mm) high.

I. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

J. Continuous Zee Base: Fabricated from 0.062-inch (1.59-mm) thickness, stainless-steel sheet.

1. Height: 4 inches (102 mm).

K. As directed Continuous or Individual Sloping Tops: Fabricated from 0.038-inch (0.95-mm) thickness, stainless-steel sheet.

L. Recess Trim: Fabricated from 0.050-inch (1.27-mm) thickness, stainless-steel sheet.

M. Filler Panels: Fabricated from 0.038-inch (0.95-mm) thickness, stainless-steel sheet.

N. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) thickness, steel sheet.

O. Materials: ASTM A666, Type 304, stainless-steel sheet.

P. Finish:

1. Tops, Bottoms, Sides, Backs, and Shelves: No. 2B or No. 4.
2. Frames: No. 3 or No. 4.
3. Doors: Manufacturer's standard patterned finish.

2.4 FABRICATION

A. Fabricate coin-operated lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each coin-operated locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. For welded assemblies, factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

D. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.
4. Coat Rods: As indicated on Drawings, For each compartment of each locker, In lieu of ceiling hook for coin-operated lockers 24 inches (610 mm) high or more or In lieu of ceiling hook for coin-operated lockers 18 inches (457 mm) deep or more.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

H. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

I. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

K. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of non-recessed coin-operated lockers; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor coin-operated locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of coin-operated lockers to walls near top and bottom of lockers or of lockers and to floor.
3. Anchor back-to-back, coin-operated lockers to floor.

B. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed coin-operated lockers with concealed clips.
2. Attach filler panels with concealed fasteners.
3. Attach sloping-top units to coin-operated lockers, with closures at exposed ends.
4. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed coin-operated lockers.

END OF SECTION 105113.13

SECTION 105116 - WOOD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wood-faced wood lockers and benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. As directed.

C. Shop Drawings: For wood lockers.

   1. Include plans, elevations, sections, and attachment details.
   2. Show locker identification system and numbering sequence.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. As directed.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature at operating levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 WOOD-FACED WOOD LOCKERS

A. Construction Style: Manufacturer's standard, Flush overlay, reveal overlay or as indicated.

1. Reveal Dimension: 1/2 inch (13 mm) or as indicated.

B. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Side, Top, and Bottom Panels: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
2. Back Panel: Manufacturer's standard 1/2 or 3/8 inch (13 or 9.5 mm) thick.
3. Exposed Panel Edges: As directed Thermoset decorative overlay to match panel, 1-mm-thick PVC, 3-mm-thick PVC or Solid wood to match doors.

C. Flush, Wood-Faced Doors: As directed Wood veneer applied over 3/4-inch- (19-mm-) thick, particleboard, medium-density-fiberboard or hardwood-plywood core, with solid wood pull of same wood species as face veneer for full length of door.

1. Wood Veneer: As directed Red oak, plain sliced or Species and cut as indicated.
2. Wood Edges: As directed 1/4-inch (6-mm) or 1-inch (25-mm) thick, solid wood of same wood species as face veneer.
3. PVC Edges: 3 mm thick.

D. Raised-Panel, Wood-Faced Doors: Stiles, rails, and center panel fabricated from 3/4-inch (19-mm) thick, wood-faced, medium-density fiberboard.

1. Wood Veneer: As directed Red oak, plain sliced or Species and cut as indicated.

E. Louver Wood Doors: As directed Solid-wood stiles and rails, 3/4 inch (19 mm) or 1-1/8 inches (29 mm) thick, with 1/4-inch (6-mm) thick, angled, solid-wood louver panels fixed in position. Dowel and glue stile-and-rail joints. Provide red oak, plain sawn or species and cut as indicated.

F. End Panels: Match style, material, construction, and finish of wood-faced wood doors.

G. Shelves: As directed Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; fixed, fixed unless otherwise indicated, adjustable or fixed and adjustable, as indicated.

1. Thickness: 3/4 inch (19 mm).
2. Exposed Edges: As directed Thermoset decorative overlay to match panels, 1-mm-thick PVC, 3-mm-thick PVC or Solid wood to match doors.

H. Drawer Faces: Match style, material, construction, and finish of wood-faced wood doors. Attach drawer faces to subfronts with mounting screws from drawer interior.

I. Drawer Subfronts, Sides, and Backs: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Thickness: 1/2 inch (13 mm).
2. Exposed Edges: As directed Thermoset decorative overlay to match panel, 1-mm-thick PVC, 3-mm-thick PVC or Solid wood to match doors.

J. Drawer Bottoms: 1/4-inch (6-mm) thick, thermoset decorative overlay over particleboard core.

K. Corners and Filler Panels: 3/4-inch (19-mm) thick panel. Match style, material, construction, and finish of wood-faced wood doors.

L. Continuous Finish Base: Wood-faced, 3/4-inch (19-mm) thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

M. Continuously Sloping Tops: Wood-faced, 3/4-inch (19-mm) thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Closures: As directed Vertical or Hipped-end type.

N. Transparent Finish: Manufacturer's standard two-coat, clear, catalyzed lacquer finish with sanding between coats. Seal with moisture-resistant topcoat.

1. Stain: As directed None required, Match approved sample for color or Match Architect's sample.

O. Painted Finish: Manufacturer's standard two-coat, painted acrylic finish.

1. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

2.3 MATERIALS

1. As directed.

B. Solid Wood: Clear hardwood lumber, selected for compatible grain and color.

C. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
2. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
3. Particleboard: As directed ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

D. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

E. Wood Support Base: As directed 2-by-4-inch nominal-size (51-by-102-mm actual-size) or 2-by-6-inch nominal-size (51-by-152-mm, actual-size) lumber treated with manufacturer's standard preservative-treatment, non-pressure or pressure process.

2.4 HARDWARE

A. Cam Padlock Hasp: Surface mounted, steel; finished to match other locker hardware.

B. Cylinder Lock: Built-in, flush cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.

1. Key Type: As directed Flat, Grooved, with minimum 2-by-2.68-inch (51-by-68.3-mm) key head for accessible lockers.
2. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

C. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

1. Bolt Operation: As directed Manually locking deadbolt or Automatically locking spring bolt.

D. Built-in, Card-Operated Lock: Self-contained units mounted to door interior with replaceable lock cylinders, keyed separately and master keyed. Mount instruction decals to both door faces. Furnish one change card key for each lock and one master card key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

E. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.

1. Designed for permanently assigned access via entry of user's four-digit code.
2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

F. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle, steel hinges; back mounted.

1. As directed Provide two hinges for doors 36 inches (914 mm) or 42 inches (1066 mm) high and less.
2. As directed Provide three hinges for doors more than 36 inches (914 mm) or 42 inches (1066 mm) high.

G. Semi-concealed Hinges: Single-pivot, spring-loaded, steel hinges; back mounted.

1. As directed, Provide two hinges for doors 36 inches (914 mm) or 42 inches (1066 mm) high and less.
2. As directed Provide three hinges for doors more than 36 inches (914 mm) or 42 inches (1066 mm) high.

H. Frameless Hinges (European Type): Fully concealed, self-closing, nickel-plated steel, with not less than 125 degrees of opening.

1. As directed, Provide two hinges for doors 36 inches (914 mm) or 42 inches (1066 mm) high and less.
2. As directed, Provide three hinges for doors more than 36 inches (914 mm) or 42 inches (1066 mm) high.

I. Wire Pulls: Back mounted; As directed 4 inches (1020 mm) long, 5/16 inch (8 mm) in diameter or 5 inches (127 mm) long, 2-1/2 inches (62 mm) deep, and 5/16 inch (8 mm) in diameter.

J. Knobs: Metal; back mounted; As directed 1-inch (25-mm), 1-1/2-inch (38-mm) diameter, flat round or ball shape.

K. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

L. Shelf Rests: BHMA A156.9, B04013.

M. Drawer Slides: As directed Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings and rated for a load of 75 lbf (330 N) or 100 lbf (440 N).

N. Drawer Locks: Cam padlock hasp or cylinder lock; surface mounted on inside of drawer.

O. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; As directed brass finished, chrome finished, epoxy coated or finished to match other locker hardware. Attach hooks with at least two fasteners.

1. Provide hooks as indicated on Drawings.
2. As directed Provide one double-prong ceiling hook and two single-prong wall hooks for each compartment of single-tier, double-tier triple-tier and open-front lockers.

P. Coat Rods: As directed 1-inch (25-mm) or 3/4-inch (19-mm) diameter steel; finished to match other locker hardware.

1. Provide coat rods as indicated on Drawings.
2. Provide coat rod for each compartment of single-tier lockers.

Q. Exposed Hardware Finish: As directed Polished chrome, Polished brass, Satin chrome or Satin brass unless otherwise indicated.

2.5 ACCESSORIES

A. Door Trays: Fabricated from solid wood, of same species as wood-faced wood doors.

B. Mirrors: ASTM C1036, Type I, Class 1, Quality q2.

1. Frame: Solid wood, of same species as wood-faced wood doors.

C. Security Lock Boxes: 6 inches wide by 6 inches high (152 mm wide by 152 mm high) by depth of locker; fabricated from same panels as locker side walls; As directed with piano hinge and cylinder or built-in combination lock.

D. Security Vaults: 6 inches wide by 4 inches high by 6 inches deep (152 mm wide by 102 mm high by 152 mm deep); fabricated from steel sheet; with built-in combination lock.

E. Protective Mats: 1/8-inch (3-mm) thick, solid rubber.

F. Number Identification Plates: As directed 1-1/2-inch (38-mm) diameter, etched, embossed, or stamped, brass, aluminum, stainless-steel or plastic plates with black numbers and letters at least 1/2 inch (13 mm) high. Identify lockers in sequence indicated on Drawings. Finish plates to match other wood locker hardware.

G. Name Identification Plates and Plate Holders: As directed 1-inch-high by 4-inch-wide (25-mm-high by 102-mm-wide), etched, embossed, or stamped, brass, aluminum, stainless-steel or plastic plates with black letters at least 1/2 inch (13 mm) high. Identify lockers as indicated on Drawings. Finish nameplates and holders to match other locker hardware.

H. Lighting: LED luminaires integrated within locker body.

1. Comply with NFPA 70.
2. Operation: As directed Door switch or motion sensor.

I. Electrical Outlets: Integrated within locker body. Comply with NFPA 70.

1. Duplex Convenience Receptacles: 112 V, 20A, NEMA WD 6 Configuration 5-20R.

a. Wall Plates: Manufacturer's standard. Coordinate with Section 262726 "Wiring Devices."

2. USB Charging Receptacles: 5 V dc, 4.2 A (minimum), USB Type A.

a. USB Receptacles: Dual and quad, Type A.
b. Wall Plates: Manufacturer's standard. Coordinate with Section 262726 "Wiring Devices."

2.6 BENCHES

A. End-Panel Locker Benches: Bench top supported between vertical end supports, as follows:

1. End Supports: As directed 4-inch (102-mm) or 3-inch (76-mm) thickness, with height and width 1 inch (25 mm) more than, 2 inches (51 mm) more than or same as height and width of bench.

    a. Finish: Match style, material, and finish of locker doors.

2. Bench Top: 3-inch (76-mm) thick, particleboard core. Provide 1/2-inch (13-mm) radius top edges on bench sides.

    a. Width: As directed 15 inches (381 mm) or 17 inches (432 mm) or except provide minimum 20-inch (508-mm) width where accessible benches are indicated.
    b. Height: 18 inches (457 mm) measured from top of bench to floor.
    c. Length: As directed 36 inches (914 mm), 48 inches (1219 mm), 60 inches (1524 mm) or 72 inches (1829 mm).
    d. Finish: Match style, material, and finish of locker doors.

B. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 18 inches (457 mm) measured from top of bench to floor, as follows:

1. Wood Pedestal Legs: Solid wood, in inverted-T shape. Match style, material, and finish of locker doors.
2. Metal Pedestal Legs: As directed 1-1/2-inch (38-mm) diameter, stainless-steel round tube or pipe, square, stainless-steel tube, square, brass tube, diameter, solid aluminum or square, painted steel tube.
3. Bench Tops: 1-1/4 inches (32 mm) deep; fabricated as follows:

    a. Butcher Block Top: Solid laminated hardwood of species and finish to match locker doors.
    b. Wood Top: Match style, material, and finish of locker doors.
    c. Width: As directed 15 inches (381 mm) or 17 inches (432 mm) or except provide minimum 20-inch (508-mm) width where accessible benches are indicated.
    d. Length: As directed 36 inches (914 mm), 48 inches (1219 mm), 60 inches (1524 mm) or 72 inches (1829 mm).

4. Bench Backs: Back support for full width of bench, secured to bench.

    a. Construction: Match style, material, and finish of bench top:
    b. Height: Beginning at a point no more than 2 inches (51 mm) above the seat surface to a height no less than 18 inches (457 mm) above the seat surface.

2.7 FABRICATION

A. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

B. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

C. Venting: As directed Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch (6 mm) or 3/4 inch (19 mm), with painted metal security screen attached to each shelf between doors.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood support base with 1/2-inch (13-mm) thick, plywood top.

B. Install lockers level, plumb, and true; use concealed shims.

C. Connect groups of lockers together with manufacturer's standard brass-finished fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Locker Anchorage: Fasten lockers through wood locker base, at ends, and not more than 36 inches (910 mm) o.c. with No. 8 flush-head wood screws sized for 1-inch (25-mm) penetration into wood base.

F. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or furring and spaced not more than 16 inches (400 mm) o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Attach sloping-top units to lockers, with end panels covering exposed ends.

I. Install number identification plates and name identification plates and holders after lockers are in place.

J. Provide protective mat at each shoe shelf.

K. Fixed Locker Benches: Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

L. Movable Locker Benches: Place benches in locations indicated on Drawings.

M. Electrical Connections: Conceal conductors and cables.

END OF SECTION 105116

SECTION 105123 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic-laminate-clad wood lockers and related benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For plastic-laminate-clad wood lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker identification system and numbering sequence.

D. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature at operating levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions as directed.

2.2 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

A. Construction Style: As directed.

1. Reveal Dimension: 1/2 inch (13 mm).

B. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Side, Top, and Bottom Panels: Manufacturer's standard 3/4 or 5/8 inch (19 or 16 mm) thick.
2. Back Panel: Manufacturer's standard 1/2 or 3/8 inch (13 or 9.5 mm) thick.
3. Exposed Panel Edges: As directed.

C. Plastic-Laminate-Clad Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of particleboard or medium-density-fiberboard core as directed.

1. Thickness: 3/4 or 5/8 inch (19 or 16 mm) thick.
2. Panel Edges: As directed.

D. End Panels: Match style, material, construction, and finish of plastic-laminate-clad wood doors.

E. Shelves: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay; As directed.

1. Thickness: 3/4 inch (19 mm).
2. Exposed Edges: As directed.

F. Drawer Faces: Match style, material, construction, and finish of plastic-laminate-clad wood doors. Attach drawer faces to subfronts with mounting screws from drawer interior.

G. Drawer Subfronts, Sides, and Backs: Fabricated from particleboard-core panels covered on both sides with thermoset decorative overlay.

1. Thickness: 1/2 inch (13 mm).
2. Exposed Edges: As directed.

H. Drawer Bottoms: 1/4-inch (6-mm) thick, thermoset decorative overlay over particleboard core.

I. Corners and Filler Panels: 3/4-inch (19-mm) thick panels. Match style, material, construction, and finish of plastic-laminate-clad wood doors.

J. Continuous Finish Base: Plastic-laminate-clad, 3/4-inch (19-mm) thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

K. Continuously Sloping Tops: Plastic-laminate-clad, 3/4-inch (19-mm) thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Closures: Vertical or Hipped-end type as directed.

L. Plastic-Laminate Colors, Patterns, and Finishes:

1. As indicated by manufacturer's designations.
2. Match Architect's samples.
3. As selected by Architect from plastic-laminate manufacturer's full range as directed.

2.3 MATERIALS

A. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
2. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
3. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue as directed.
4. Softwood Plywood: DOC PS 1, medium-density overlay.

B. High-Pressure Decorative Laminate: NEMA LD 3, grades as follows:

1. Horizontal Surfaces: Grade HGS or Grade HGL, as directed.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS or Grade VGS, as directed.

C. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Wood Support Base: 2-by-4-inch nominal-size (51-by-102-mm, actual-size) or 2-by-6-inch, nominal-size (51-by-152-mm, actual-size) lumber treated with manufacturer's standard preservative-treatment, non-pressure or pressure process as directed.

2.4 HARDWARE

A. Cam Padlock Hasp: Surface mounted, steel; finished to match other locker hardware.

B. Cylinder Lock: Built-in, flush cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.

1. Key Type: Flat or Grooved as directed, with minimum 2-by-2.68-inch (51-by-68.3-mm) key head for accessible lockers, as directed.
2. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt, as directed.

C. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt, as directed.

D. Built-in, Card-Operated Lock: Self-contained units mounted to door interior with replaceable lock cylinders, keyed separately and master keyed. Mount instruction decals to both door faces. Furnish one change card key for each lock and one master card key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt, as directed.

E. Digital Keypad Lock: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.

1. Designed for permanently assigned access via entry of user's four-digit code.
2. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

F. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges; back mounted.

1. Provide two hinges for doors 36 inches (910 mm) or 42 inches (1067 mm) high and less, as directed.
2. Provide three hinges for doors more than 36 inches (910 mm) or 42 inches (1070 mm) high, as directed.

G. Semi-concealed Hinges: Single-pivot, spring-loaded steel hinges; back mounted.

1. Provide two hinges for doors 36 inches (910 mm) or 42 inches (1070 mm) high and less, as directed.
2. Provide three hinges for doors more than 36 inches (910 mm) or 42 inches (1070 mm) high, as directed.

H. Frameless Hinges (European Type): Fully concealed, self-closing, nickel-plated steel, with not less than 125 degrees of opening.

1. Provide two hinges for doors 36 inches (910 mm) or 42 inches (1070 mm) high and less, as directed.
2. Provide three hinges for doors more than 36 inches (910 mm) or 42 inches (1070 mm) high, as directed.

I. Wire Pulls: Back mounted; 4 inches (102 mm) long, 5/16 inch (8 mm) in diameter or 5 inches (127 mm) long, 2-1/2 inches (62 mm) deep, and 5/16 inch (8 mm) in diameter, as directed.

J. Knobs: Metal; back mounted; 1-inch- (25-mm-) or 1-1/2-inch- (38-mm-) diameter as directed, flat round or ball shape, as directed.

K. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

L. Shelf Rests: BHMA A156.9, B04013.

M. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, rated for a load of 75 lbf (330 N) or 100 lbf (440 N) as directed.

N. Drawer Locks: Cam padlock hasp or cylinder lock; surface mounted on inside of drawer.

O. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; As directed. Attach hooks with at least two fasteners.

1. Provide hooks as indicated on Drawings.
2. Provide one double-prong ceiling hook and two single-prong wall hooks for each compartment of lockers, as directed.

P. Coat Rods: 1-inch (25-mm) or 3/4-inch (19-mm) diameter steel as directed; finished to match other locker hardware.

1. Provide coat rods as indicated on Drawings.
2. Provide coat rod for each compartment of single-tier lockers.

Q. Exposed Hardware Finish: As directed.

2.5 ACCESSORIES

A. Door Trays: Fabricated from solid wood.

B. Mirrors: ASTM C1036, Type I, Class 1, Quality q2.

1. Frame: Solid wood.

C. Security Lock Boxes: 6 inches wide by 6 inches high (152 mm wide by 152 mm high) by depth of locker; with piano hinge and cylinder or built-in combination lock as directed.

D. Security Vaults: 6 inches wide by 4 inches high by 6 inches deep (152 mm wide by 102 mm high by 152 mm deep); fabricated from steel sheet; with built-in combination lock.

E. Protective Mats: 1/8-inch (3-mm) thick, solid rubber.

F. Number Identification Plates: 1-1/2-inch (38-mm) diameter, etched, embossed, or stamped, plates as directed with black numbers and letters at least 1/2 inch (13 mm) high. Identify lockers in sequence indicated on Drawings. Finish plates to match other locker hardware.

G. Name Identification Plates and Plate Holders: 1-inch-high by 4-inch-wide (25-mm-high by 102-mm-wide), etched, embossed, or stamped, plates as directed with black letters at least 1/2 inch (13 mm) high. Identify lockers as indicated on Drawings. Finish nameplates and holders to match other locker hardware.

2.6 BENCHES

A. End-Panel Locker Benches: Bench top supported between vertical end supports, as follows:

1. End Supports: 4-inch (102-mm) or 3-inch (76-mm) thickness as directed, with height and width of bench as directed.

    a. Finish: Match style, material, construction, and finish of plastic-laminate-clad locker doors.

2. Bench Top: 3-inch (76-mm) thick, particleboard core. Provide 1/2-inch (13-mm) radius top edges on bench sides.

    a. Width: 15 inches (381 mm) or 17 inches (432 mm) as directed except provide minimum 20-inch (508-mm) width where accessible benches are indicated.
    b. Height: 18 inches (457 mm) measured from top of bench to floor.
    c. Length: As directed.
    d. Finish: Bond the following material to core:

        1) High-Pressure Decorative Laminate: As directed.

B. Pedestal-Leg Locker Benches: Bench top supported by pedestal legs, minimum of two pedestals for each bench, with overall height of 18 inches (457 mm) measured from top of bench to floor, as follows:

1. Wood Pedestal Legs: Solid wood, in inverted-T shape. Match finish of locker doors.
2. Metal Pedestal Legs: 1-1/2-inch (38-mm) as directed.
3. Bench Tops: 1-1/4 inches (32 mm) deep; fabricated as follows:

    a. Butcher Block Top: Solid laminated hardwood.
    b. High-Pressure Decorative Laminate Top: Post formed over particleboard core, with color as directed.
    c. Width: As directed.
    d. Length: As directed.

4. Bench Backs: Back support for full width of bench, secured to bench.

    a. Construction: Match style, material, and finish of bench top:
    b. Height: Beginning at a point no more than 2 inches (51 mm) above the seat surface to a height no less than 18 inches (457 mm) above the seat surface.

2.7 FABRICATION

A. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

B. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

C. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch (6 mm) or 3/4 inch (19 mm) as directed, with painted metal security screen attached to each shelf between doors.

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

A. Install wood support base with 1/2-inch (13-mm) thick, plywood top.

B. Install lockers level, plumb, and true; use concealed shims.

C. Connect groups of lockers together with manufacturer's standard brass-finished fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Locker Anchorage: Fasten lockers through wood locker base, at ends, and not more than 36 inches (910 mm) o.c. with No. 8 flush-head wood screws sized for 1-inch (25-mm) penetration into wood base.

F. Locker Anchorage: Fasten lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or furring and spaced not more than 16 inches (400 mm) o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Attach sloping-top units to lockers, with end panels covering exposed ends.

I. Install number identification plates and name identification plates and holders after lockers are in place.

J. Provide protective mat at each shoe shelf.

K. Fixed Locker Benches: Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

L. Movable Locker Benches: Place benches in locations indicated on Drawings.

END OF SECTION 105123

SECTION 105143 - WIRE MESH STORAGE LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wire mesh storage lockers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

A. Steel Wire: ASTM A510 (ASTM A510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B, with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

E. Seismic Bracing: Angles with legs not less than 1-1/4 inch (32 mm) wide, formed from 0.040-inch- (1.0-mm-) thick, metallic-coated steel sheet; with bolted connections and 1/4-inch- (6-mm-) diameter bolts.

F. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

G. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.

H. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.3 WIRE MESH STORAGE LOCKERS

A. Unit Sizes:

1. Width: As directed 36 inches (914 mm) or 48 inches (1219 mm).
2. Depth: As directed 36 inches (914 mm), 48 inches (1219 mm) or 60 inches (1524 mm).
3. Height: 90 inches (2286 mm)

B. Mesh: As directed 0.135-inch (3.5-mm) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond or 1-by-2-inch (25-by-50-mm) rectangular mesh.

C. Wall Panels: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm) steel angle framing on top, bottom, and back sides, and 3-by-1/8-inch (76-by-3-mm) cold-rolled steel flat bar framing on front side, with wire mesh welded to framing.

1. Horizontal Panel Stiffeners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm) steel angles or 3/4-by-1/4-inch (19-by-6-mm) hot-rolled steel flat bars.

D. Backs: As directed 0.028-inch (0.71-mm) or 0.034-inch (0.86-mm) thick, metallic-coated steel sheet. Required for back-to-back units only.

E. Doors: Fabricated from same mesh as wall panels, with framing fabricated from 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3-mm) steel angles on four sides with wire mesh welded to framing. Include padlock hasp.

1. Horizontal Stiffeners for Single-Tier Doors: 3/4-by-1/4-inch (19-by-6-mm) steel flat bars.
2. Hinges: Full-surface type, 2-1/2-by-2-1/2-inch (64-by-64-mm) steel, 1-1/2 pairs per single-tier door; bolted, riveted, or welded to door and jamb framing.

F. Finish for Uncoated Ferrous Steel: As directed Hot-dip galvanized, Shop primed for field painting or Enamel or powder-coated finish unless otherwise indicated.

1. Color: As indicated by manufacturer's designations, Match Architect's samples or As selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. General: Fabricate wire mesh storage lockers from components of sizes not less than those indicated. Use larger size components as recommended by wire mesh manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh storage lockers to be readily disassembled.
2. Welding: As directed Weld corner joints of framing and grind smooth, leaving no evidence of joint, finish sand, remove spatter or leave as applied.

B. Wire Mesh Storage Lockers: Fabricate initial storage locker with front and two sides. Fabricate additional storage lockers as add-on units designed to share one side with initial storage locker.

1. Fabricate wall panel and door framing with slotted holes for connecting adjacent panels.
2. Pre-hang doors in factory.

2.5 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

B. Preparation for Shop Priming: As directed Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" or SSPC-SP 3, "Power Tool Cleaning".

C. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

D. Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel or powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 WIRE MESH STORAGE LOCKERS ERECTION

A. Anchor wire mesh storage lockers to floor with 3/8-inch (9.5-mm) diameter expansion anchors at 12 inches (305 mm) o.c. through bottom panel framing. Shim panel framing as required to achieve level and plumb installation.

B. Anchor wire mesh storage lockers to walls at 12 inches (305 mm) o.c. through back corner panel framing.

C. Attach adjacent wire mesh storage lockers to each other through side panel framing.

D. Install doors complete with door hardware.

3.2 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily without binding or warping. Adjust hardware to function smoothly. Confirm that hasps engage accurately and securely without forcing or binding.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 105143

SECTION 105500.13 - USPS-DELIVERY POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mail receptacles.
2. Cluster box units.
3. Parcel lockers.
4. Collection boxes.
5. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For postal specialties. Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Furnish lock keys according to USPS requirements; with temporary identification for their respective locks, bagged, and securely taped inside the collection compartment for shipping.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MAIL RECEPTACLES

A. Front-Loading Mail Receptacles: USPS-STD-4C; consisting of multiple compartments with fixed, solid compartment backs, enclosed within a recessed wall box.

1. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.

    a. Master-Door Lock: Door prepared to receive lock provided by local postmaster.

2. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

    a. Type I: A group of mail receptacles in single-column configuration with single master door, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one parcel-locker compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
    b. Type II: A group of mail receptacles in double-column configuration with double master door, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one or two parcel-locker compartment(s): 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
    c. Type III: A group of mail receptacles in double-column configuration with single master door, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment prepared for master-door lock, and one or two parcel-locker compartment(s): As directed 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
    d. Type VI (No Parcel-Locker Compartment): A group of mail receptacles in single-column configuration with single master door, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.
    e. Type VIII (No Parcel-Locker Compartment): A group of mail receptacles in double-column configuration with double master door, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment prepared for master-door lock.

3. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by USPS-STD-4C. Provide mail slot in the compartment with master-door lock.

a. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
b. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.

4. Frames: Extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
5. Concealed Components and Mounting Frames: Aluminum or steel sheet.
6. Exposed Aluminum Finish:

a. Baked-Enamel or Powder-Coated Finish: As directed Silver, Black, Medium bronze, Dark bronze, Gold, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

B. Rear-Loading Mail Receptacles: USPS-STD-4C; consisting of multiple compartments enclosed within a recessed wall box.
1. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

a. Type IV: A group of mail receptacles in single-column configuration with a rear-access cover, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one parcel-locker compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
b. Type V: As directed A group of mail receptacles in double-column configuration with a rear-access cover, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), one outgoing mail collection compartment, and one or two parcel-locker compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).
c. Type VII (No Parcel-Locker Compartment): A group of mail receptacles in single-column configuration with a rear-access cover, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.
d. Type IX (No Parcel-Locker Compartment): A group of mail receptacles in double-column configuration with a rear-access cover, three mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep (76 mm high by 305 mm wide by 381 mm deep), and one outgoing mail collection compartment.

2. Rear-Loading Cover: As directed Not required or Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit.
3. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other.
4. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by USPS-STD-4C. One compartment with outgoing mail slot.

a. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
b. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.

5. Frames: Extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
6. Snap-on Trim: Fabricated from same material and finish as compartment doors.
7. Concealed Components and Mounting Frames: Aluminum or steel sheet.
8. Exposed Aluminum Finish:

a. Baked-Enamel or Powder-Coated Finish: Silver, Black, Medium bronze, Dark bronze, Gold, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

2.2 CLUSTER BOX UNITS (CBUs)

A. Cluster Box Units (CBUs): USPS-B-1118G; consisting of multiple compartments enclosed within a freestanding, pedestal-mounted enclosure.

B. Compartment Enclosure: Aluminum sheet with aluminum mounting pedestal and weather-protection hood, with the following number and size of compartments:

1. Type I: Eight compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel-locker compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).
2. Type II: 12 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), and one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).
3. Type III: 16 compartments 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 3 inches high by 15 inches deep (305 mm wide by 76 mm high by 381 mm deep), one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep), and another parcel-locker compartment 12 inches wide by 13-1/2 inches high by 15 inches deep (305 mm wide by 343 mm high by 381 mm deep).
4. Type IV: 13 compartments 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), one outgoing mail compartment 12 inches wide by 4-3/4 inches high by 15 inches deep (305 mm wide by 121 mm high by 381 mm deep), and one parcel-locker compartment 12 inches wide by 10 inches high by 15 inches deep (305 mm wide by 254 mm high by 381 mm deep).

C. Compartment Doors and Frames: One-piece extruded aluminum or aluminum sheet. Equip each compartment door with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide outgoing mail slot with weather protection flap.

1. Tenant Identification: As directed Number engraved into face or applied into recess of compartment door.
2. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
3. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.

D. Pedestal: Aluminum, with same finish as compartment enclosure and attached with theft-resistant fasteners.

E. Exposed Aluminum Finish: Finish surfaces exposed to view with powder-coated finish in postal gray (light gray).

2.3 PARCEL LOCKERS

A. Front-Loading Parcel Lockers, Recessed: USPS-STD-4C; consisting of single or multiple compartments enclosed within a larger enclosure of type indicated below.
1. Enclosure Type: Recessed.
2. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

a. Type X, Parcel Only: As directed Single parcel receptacle 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) or 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep) without a master door.
b. Type X, Parcel Only: A group of parcel receptacles in single-column configuration without a master door; As directed one or two compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep)and one compartment 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep).
c. Type XI, Parcel Only: A group of parcel receptacles in single-column configuration with single master door prepared for master-door lock; As directed one, two or compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one two compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).

3. Front-Loading Master Door: Fabricated to hold compartment doors; prepared to receive master-door lock provided by local postmaster.
4. Compartment Doors and Frames: As directed Fabricated from same material and finish as adjacent mail receptacles, extruded aluminum, aluminum sheet or metallic-coated steel sheet. Equip each compartment door with lock; identification; and concealed, full-length, spring-loaded, flush hinge on right side.

a. Compartment Identification: As directed Black, sequential numbers engraved into or stamped onto recess in face of compartment door.

b. Compartment-Door Locks: Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C) and parcel-locker key opens compartment and is retained once opened.

5. Aluminum Finish:

a. Baked-Enamel or Powder-Coated Finish: As directed Silver, Black, Medium bronze, Dark bronze, Gold, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

B. Rear-Loading Parcel Lockers, Recessed: USPS-STD-4C; consisting of single or multiple compartments enclosed within a recessed wall box.

1. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

a. Type XII, Parcel Only: A group of parcel receptacles in single-column configuration with a rear-access cover; As directed one, two, compartment(s) 15 inches high by 12 inches wide by 15 inches deep (381 mm high by 305 mm wide by 381 mm deep) and one or two compartment(s) 18 inches high by 12 inches wide by 15 inches deep (457 mm high by 305 mm wide by 381 mm deep).

2. Rear-Loading Cover: As directed Not required or Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit.
3. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other.
4. Compartment Doors and Frames: As directed Fabricated from same material and finish as adjacent mail receptacles, extruded aluminum, aluminum sheet, metallic-coated steel sheet or aluminum or metallic-coated steel sheet. Equip each compartment door with lock; identification; and concealed, full-length, spring-loaded, flush hinge on one side.

a. Compartment Identification: As directed Black, sequential numbers engraved into or stamped onto recess in face of compartment door.
b. Compartment-Door Locks: Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C) and parcel-locker key opens compartment and is retained once opened.

5. Exposed Aluminum Finish:

a. Baked-Enamel or Powder-Coated Finish: Silver, Black, Medium bronze, Dark bronze, Gold, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

2.4 COLLECTION BOXES

A. Collection Boxes: As directed Consisting of single compartment with fire-resistant cushion bottom, enclosed within wall box, with mail slot or hopper door to receive mail. Provide door for collecting mail from front or rear of unit.
1. Mounting: As directed Recessed, Semi-recessed or Surface mounted.

2. Height: As directed Sized to match height of four, five, six or seven mail receptacles.
3. Height: As indicated on Drawings.
4. Front-Loading Compartment Doors and Frames: Fabricated from 1/4-inch- (6-mm-) thick aluminum, with opening not less than 12 by 20 inches (305 by 508 mm) and not more than 18 by 30 inches (457 by 762 mm). Equip door with lock and concealed, full-length, flush hinge on one side.

    a. Door Lock: Door prepared to receive lock provided by local postmaster.
    b. Identification: Engrave face of compartment door with 1-inch- (25-mm-) high letters as follows: "U.S. MAIL LETTER BOX" on two lines at top or bottom of unit.
    c. Door Style: As directed Set door within face frame or Extend door full width and height of unit, with no exposed frame.

5. Rear-Loading Enclosure: Lift-off rear cover fabricated from same material and finish as front of unit.
6. Rear-Loading Door: Side hinged, with opening not less than 12 by 20 inches (305 by 508 mm) and not more than 18 by 30 inches (457 by 762 mm), from same material and finish as front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching mechanism on the other. Fabricate rear-loading door to remain open while mail is collected.
7. Mail Slot: Fabricated from 1/4-inch- (6-mm-) thick aluminum, with 11-inch-wide by 1-1/4-inch- (279-mm-wide by 32-mm-) high opening, protected by inside hood and hinge flap, and with inside baffle to prevent removal of mail from box.
8. Hopper Door: Fabricated from 1/4-inch- (6-mm-) thick aluminum, with opening that allows a bundle measuring 6-1/2 inches wide by 11-1/2 inches long by 4 inches high (165 mm wide by 292 mm long by 102 mm high) to be deposited, and with inside baffle to prevent removal of mail from box. Equip door with door pull and concealed, full-length bottom hinge.

    a. Identification: Engrave face of hopper door with 1-inch- (25-mm-) high letters as follows: "LETTERS AND LETTER MAIL TIED IN BUNDLES."
    b. Door Style: As directed Set door within face frame or Extend door full width and height of unit, with no exposed frame.

9. Exposed Materials:

    a. Anodic Finish: Clear.
    b. Baked-Enamel or Powder-Coated Finish: As directed.

10. Concealed Components and Mounting Frames: Aluminum or steel sheet.
11. Schedule-Card Holder: Recessed or surface-mounted holder for pickup schedule card in center of bottom front portion of unit. Same material and finish as front of unit.
12. Mailbag Hooks: Two aluminum or stainless-steel hooks at exterior front edge of bottom of surface-mounted units, spaced 15 to 17-1/2 inches (381 to 445 mm) apart, for supporting mailbags.
13. Mailbag Rack: Internal rack system for supporting mailbags within unit.

2.5 ACCESSORIES

A. Key Keeper: Consisting of single compartment with door; interior compartment size not less than 4-3/4 inches wide by 2-1/4 inches high by 1-1/2 inches deep (121 mm wide by 57 mm high by 38 mm deep), USPS approved.
   1. Mounting: As directed Recessed or Surface mounted.
   2. Style: As directed Compartment door set within face frame or extending full width and height of unit, with no exposed frame.
   3. Type of Operation: As directed Loose key in box, Retractor reel with minimum 20-inch- (508-mm-) long chain or Push-button, 24-V switch in box.
   4. Door Lock: Door prepared to receive lock furnished by local postmaster.
   5. Exposed Materials:
      a. Anodic Finish: Clear.
      b. Baked-Enamel or Powder-Coated Finish: As directed.

2.6 FABRICATION

A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.

B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.

C. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mail Receptacles: Install mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by the USPS and manufacturer's written instructions.

B. Pedestal-Mounted Postal Specialties: Anchor units with 1/2-inch- (13-mm-) diameter, stainless-steel anchor bolts with hooked ends.

C. Collection Boxes: As directed Install collection boxes with centerline of mail slots or handle of hopper doors not more than 48 inches (1219 mm) above finished floor.

3.2 FIELD QUALITY CONTROL

A. Arrange for USPS personnel to examine and test postal specialties served by the USPS after they have been installed according to USPS regulations.

END OF SECTION 105500.13

SECTION 105500.16 - PRIVATE-DELIVERY POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Horizontal mail receptacles.
2. Vertical mail receptacles.
3. Mail collection boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For postal specialties. Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Furnish lock keys with temporary identification for their respective locks, bagged, and securely taped inside the collection compartment for shipping.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HORIZONTAL MAIL RECEPTACLES

A. Front-Loading, Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box.

1. Front-Loading Master Door: Braced and framed to hold compartment doors; with master-door lock and concealed, full-length, stainless-steel piano hinge on one side. Fabricate master door to remain open while mail is deposited.

    a. Master-Door Lock: Manufacturer's standard five-pin tumbler, cylinder lock; with two or three keys As directed.

2. Compartments: As directed Manufacturer's standard compartments with extruded aluminum, die-cast brass or die-cast zinc doors. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot.

    a. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

        1) Size 1: As directed Provide number of compartments with inside dimensions not less than 3 inches high by 6 inches wide by 15 inches deep (76 mm high by 152 mm wide by 381 mm deep).
        2) Size 2: As directed Provide number of compartments with inside dimensions not less than 5 inches high by 3-1/2 inches wide by 15 inches deep (127 mm high by 89 mm wide by 381 mm deep).
        3) Size 3: As directed Provide number of compartments with inside dimensions not less than 5 inches high by 7-1/2 inches wide by 15 inches deep (127 mm high by 191 mm wide by 381 mm deep).
        4) Size 4: As directed Provide number of compartments with inside dimensions not less than 10-1/2 inches high by 3-1/2 inches wide by 15 inches deep (267 mm high by 89 mm wide by 381 mm deep).
        5) Size 5: As directed Provide number of compartments with inside dimensions not less than 10-1/2 inches high by 7-1/2 inches wide by 15 inches deep (267 mm high by 191 mm wide by 381 mm deep).

3. Compartment-Door Locks: As directed Five-pin tumbler, cylinder cam or spring-latch-type locks capable of at least 1000 key changes; with two or three keys for each compartment door. Key each compartment differently.
4. Frames: Ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
5. Snap-on Trim: Fabricated from the same material and finish as compartment doors.
6. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
7. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:

    a. Anodic Finish: Clear.
    b. Baked-Enamel or Powder-Coated Finish: As directed Black, Dark bronze, Gold, Medium bronze, Silver, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

8. Brass Finish: As directed, Buffed finish, lacquered, Hand-rubbed finish, lacquered or Brushed satin, lacquered.
9. Zinc Finish: Manufacturer's standard powder-coated finish, tan.

B. Rear-Loading, Horizontal Mail Receptacles: Consisting of multiple compartments enclosed within recessed wall box.

1. Rear-Loading Cover: As directed or Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit.
2. Rear-Loading Door: Side hinged, fabricated from extruded aluminum or aluminum sheet, finished to match front of unit; with full-length, stainless-steel piano hinge on one side and positive-latching or locking mechanism on the other. Fabricate rear-loading door to open not less than 90 degrees and to remain open while mail is deposited.

    a. Rear-Door Lock: As directed Manufacturer's standard five-pin tumbler, cylinder lock; with two or three keys.

3. Compartment Doors: As directed Manufacturer's standard compartments with extruded aluminum, die-cast brass or die-cast zinc doors. Equip each with lock, tenant identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock and with outgoing mail slot.

    a. Compartments: Number and size as follows: As indicated on Drawings, of the following sizes: As indicated on Drawings.

        1) Size 1: As directed Provide number of compartments with inside dimensions not less than 3 inches high by 6 inches wide by 15 inches deep (76 mm high by 152 mm wide by 381 mm deep).
        2) Size 2: As directed Provide number of compartments with inside dimensions not less than 5 inches high by 3-1/2 inches wide by 15 inches deep (127 mm high by 89 mm wide by 381 mm deep).
        3) Size 3: As directed Provide number of compartments with inside dimensions not less than 5 inches high by 7-1/2 inches wide by 15 inches deep (127 mm high by 191 mm wide by 381 mm deep).
        4) Size 4: As directed Provide number of compartments with inside dimensions not less than 10-1/2 inches high by 3-1/2 inches wide by 15 inches deep (267 mm high by 89 mm wide by 381 mm deep).
        5) Size 5: As directed Provide number of compartments with inside dimensions not less than 10-1/2 inches high by 7-1/2 inches wide by 15 inches deep (267 mm high by 191 mm wide by 381 mm deep).

4. Compartment-Door Locks: As directed Five-pin tumbler, cylinder cam or spring-latch-type locks capable of at least 1000 key changes; with two or three keys for each compartment door. Key each compartment differently.
5. Frames: Ganged and nested units, with cardholder and blank cards for tenant's identification behind each compartment.
6. Snap-on Trim: Fabricated from the same material and finish as compartment doors.
7. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
8. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:

    a. Anodic Finish: Clear.
    b. Baked-Enamel or Powder-Coated Finish: As directed Black, Dark bronze, Gold, Medium bronze, Silver, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

9. Brass Finish: As directed, Buffed finish, lacquered, Hand-rubbed finish, lacquered or Brushed satin, lacquered.
10. Zinc Finish: Manufacturer's standard powder-coated finish, tan.

2.2 VERTICAL MAIL RECEPTACLES

A. Vertical Mail Receptacles: Consisting of vertical compartments enclosed within wall box; with inside dimensions of each compartment not less than 15 inches high by 5 inches wide by 6 inches deep (381 mm high by 127 mm wide by 152 mm deep).
1. Mounting: As directed, recessed, Semirecessed with mounting frame, Surface mounted with mounting frame or as indicated on Drawings.
2. Compartments: Provide three or number as indicated on Drawings.
3. Compartment Doors and Frames: Fabricated from striated, extruded aluminum. Equip each compartment door with lock, slot in face of door to receive tenant identification, and concealed, full-length, flush hinge on one side. Provide one double-wide compartment with outgoing mail slot.

    a. Compartment-Door Locks: As directed Five-pin tumbler, cylinder cam or spring-latch-type locks capable of at least 1000 key changes; with two or three keys for each compartment door. Key each compartment differently.

4. Frames: Ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
5. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
6. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:

    a. Anodic Finish: Clear, Gold, As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range.
    b. Baked-Enamel or Powder-Coated Finish: As directed Aluminum, Black, Brass, Dark bronze, Gold, Green, Ivory, Medium bronze, Silver, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

2.3 MAIL COLLECTION BOXES

A. Mail Collection Boxes: Consisting of single compartment of same depth as horizontal mail receptacles, enclosed within wall box, with slot in top of front to receive mail.
1. Height: As directed Sized to match height of four, five, six or seven horizontal mail receptacles.
2. Mounting: As directed Recessed, Semi-recessed or Surface mounted.
3. Compartment Doors and Frames: As directed Fabricated from extruded aluminum or aluminum sheet that is full height of unit including or in portion of unit below mail slot, and equipped with lock and concealed, continuous side hinge.

    a. Door Lock: Cylinder lock keyed to building keying system; As directed with two or three keys.
    b. Identification: As directed Engrave face of compartment door with 1-inch- (25-mm-) high letters as follows: "LETTERS, OUTGOING MAIL or OFFICE."

4. Aluminum Finish: Finish surfaces exposed to view as follows:

    a. Anodic Finish: Clear.
    b. Baked-Enamel or Powder-Coated Finish: As directed, Black, Dark bronze, Gold, Medium bronze, Color as indicated by manufacturer's designations or Color as selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

A. Letter Drops (Through Wall): Consisting of 11-inch-wide by 3-1/2-inch- (279-mm-wide by 89-mm-) high, top-hinged, spring-loaded flap that pivots inward, held in place by 1-inch- (25-mm-) wide face frame. Fabricated from 1/4-inch- (6-mm-) thick aluminum or steel, with exposed surfaces finished to match adjacent mail receptacles.
    1. Sleeve: Provide metallic-coated steel wall sleeve for full depth of wall.
    2. Finished Frame: Provide finished face frame on back side of wall opening.
    3. Identification: As directed Engrave face of swinging flap with 1-inch- (25-mm-) high letters as follows: "LETTERS or OUTGOING MAIL."
    4. Finish: Exposed surfaces finish as adjacent mail receptacles.

B. Package Depository (Through Wall): Consisting of 1/4-inch- (6-mm-) thick, aluminum or steel faceplate and through-the-wall hopper door with hinged baffle allowing receipt of packages; fabricated from 1/4-inch- (6-mm-) thick aluminum or steel.
    1. Hopper Door: Equipped with door pull and concealed, full-length bottom hinge; with opening size not less than 15 inches wide by 6-1/2 inches high (381 mm wide by 165 mm high) or as indicated on Drawings.
    2. Sleeve: Provide metallic-coated steel wall sleeve for full depth of wall.
    3. Slowdown: Provide steel slowdown ramp on back side of wall opening.
    4. Identification: Engrave face of hopper door with 1-inch- (25-mm-) high letters as follows: "LETTERS."
    5. Finish: Exposed surfaces finished same as mail receptacles.

2.5 FABRICATION

A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.

B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.

C. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mail Receptacles: Install mail receptacles with center of tenant-door lock cylinders not more than 48 inches (1219 mm) and bottom of receptacles not less than 15 inches (381 mm) above finished floor.

B. Mail Collection Boxes: As directed Install collection boxes with centerline of mail slots or handle of hopper doors not more than 48 inches (1219 mm) above finished floor.

END OF SECTION 105500.16

SECTION 105613 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Case-type metal storage shelving.
2. Four-post metal storage shelving.
3. Post-and-beam metal storage shelving.

1.2 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: As directed.

C. Shop Drawings: For metal storage shelving.

1. Include plans, elevations, sections, and attachment details.
2. Include installation details of connectors, lateral bracing, and special bracing.

D. Samples: For each type of metal storage shelving and for each color specified.

E. Delegated-Design Submittal: For seismic restraint of metal storage shelving.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.

B. Product certificates.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Component Importance Factor: 1.5 or 1.0 as directed.

C. Sustainable Design Performance:

2.2 CASE-TYPE METAL STORAGE SHELVING

A. Case-Type Metal Shelving: Complying with MH 28.1; freestanding units and field assembled from factory-formed components. Shelves span between two independent supporting sheet metal end panels that allow shelf-height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

B. Load-Carrying Capacity per Shelf: 200 lb (91 kg), uniformly distributed.

C. End Panels: Fabricated from cold-rolled steel sheet, with concealed perforations at front and back edges at 1-inch (25 mm) o.c. for receiving adjustable shelf clips.

1. Adjustable Shelf Clips: Cold-rolled steel, with projections designed to engage at least two perforations in end panels.

D. End Panels: Fabricated from cold-rolled steel sheet; with horizontal slots spaced at 1-inch (25 mm) o.c. or 1-1/2 inches (38 mm) o.c. for supporting shelves as directed.

E. Back Panel: One piece, fabricated from cold-rolled steel sheet.

F. Shelves: Fabricated from cold-rolled steel sheet. Fabricate shelves with vertical front that is flanged and returned.

1. Shelf-Divider Slots: 2-inches (51 mm) o.c.

G. Base: Closed front, with base strips fabricated from same material and with same finish as end panels.

H. Accessories:

1. Finished End Panels: Fabricated as solid or perforated full-height panels as directed from same material and with same finish as end panels, with trim along edges abutting end panels and top shelf.
2. Shelf Dividers: Fabricated from same material and with same finish as shelves; As directed.
3. Bins: Fabricated from same material and with same finish as shelves or Plastic as directed.
4. Shelf-Label Holders: Clear or Colored plastic as directed, designed to clip onto front edge of shelf.

I. Steel Finish: Baked enamel or powder coat.

1. Color and Gloss: As directed.

2.3 FOUR-POST METAL STORAGE SHELVING

A. Open or Closed Four-Post Metal Storage Shelving As directed: Complying with MH 28.1 and field assembled from factory-formed components. Shelves span between supporting corner posts that allow shelf-height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Load-Carrying Capacity per Shelf: As directed.
2. Posts: Fabricated from hot-rolled steel as directed; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf-to-post connectors.

a. Unit Configuration: Configure shelving units as individual, freestanding or starter- and add-on unit assemblies as directed.

1) Add-On Shelf Posts: Fabricated from hot-rolled steel, as directed; perforated to match main posts.

b. Post Base: Bolt leveler or Adjustable steel floor plate, drilled for floor anchors as directed.

3. Bracing: Manufacturer's standard, single or double diagonal cross bracing.

a. Location: At unit back and ends as required for stability, load-carrying capacity of shelves, and number of shelves indicated.

4. Back Panel: One piece or Two half panels fabricated from cold-rolled steel sheet as directed.

5. End Panels: Fabricated from cold-rolled steel sheet.
6. Solid-Type Shelves: Uncoated or Metallic-coated steel sheet as directed.

    a. Slots or Holes for Shelf Dividers: 2 inches (51 mm) or 3 inches (76 mm) o.c. as directed
    b. Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.
    c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel as directed.

7. Framed-Type Wire Shelves: Steel or Metallic-coated-steel wire as directed; with shelf frame fabricated from same material and with same finish as posts.
8. Truss-Type Wire Shelves: As directed wire-over-wire construction, with downturned wire truss edges.
9. Shelf-to-Post Connectors: As directed.
10. Base: Open, with exposed post legs or Closed, with base strips fabricated from same material and with same finish as shelving as directed.
11. Accessories:

    a. Finished End Panels: Fabricated as solid or perforated as directed full-height panels from manufacturer's standard thickness cold-rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.
    b. Shelf Dividers: Fabricated from same material and with same finish as shelves as directed.
    c. Bins: Fabricated from same material and with same finish as shelves; size as indicated on Drawings.
    d. Shelf-Label Holders: Clear or Colored plastic as directed, designed to clip onto front edge of shelf.

12. Steel Finish: Baked enamel or powder coat as directed.

    a. Color and Gloss: As directed.

B. Wire-Type, Four-Post Metal Storage Shelving: Complying with MH 28.1; field assembled from factory-formed components. Shelves span between supporting corner posts that allow shelf-height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Load-Carrying Capacity per Shelf: As directed, Uniformly distributed.
2. Posts: Fabricated from 1-inch- (25-mm-) OD, square or round tubing of indicated material as directed; with grooves or notches at 1 inch (25 mm) o.c. to receive shelf-to-post connectors. Label posts with numbers at not less than 2 inches (51 mm) o.c. for determining shelf height.

    a. Post Material: Steel or Stainless steel as directed.
    b. Post Base: Bolt leveler or Adjustable steel floor plate, drilled for floor anchors as directed.
    c. Post Cap: Nylon or plastic.
    d. Unit Configuration: Configure shelving units as individual, freestanding or starter- and add-on unit assemblies as directed.

3. Framed-Type Wire Shelves: As directed wire-over-wire construction, with shelf frame fabricated from same material and with same finish as posts; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
4. Truss-Type Wire Shelves: As directed wire-over-wire construction, with downturned wire truss edges; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
5. Waterfall-Type Wire Shelves: As directed wire-over-wire waterfall construction; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
6. Shelf-to-Post Connectors: Manufacturer's standard one-piece collet (wedge), designed to engage post collar attached to shelves.
7. Bracing: Manufacturer's standard diagonal cross bracing, as required for stability, load-carrying capacity of shelves, and number of shelves.
8. Accessories:

    a. Shelf Dividers: Fabricated from same material and with same finish as shelves; as directed.
    b. Shelf Inlay: Manufacturer's standard as directed.
    c. Storage Basket: Edge-of-shelf-mounted wire basket, fabricated from same material and with same finish as shelves.
    d. Back Ledges: 1 inch (25 mm) or 4 inches (102 mm) high as directed, fabricated from same material and with same finish as shelves.
    e. Side Ledges: 1 inch (25 mm) or 4 inches (102 mm) high as directed, fabricated from same material and with same finish as shelves.
    f. Garment Hanger Tube: Width of 21 inches (533 mm) or shelves with mounting brackets as directed.
    g. Shelf-Label Holders: Designed to clip onto front edge of shelf as directed.

9. Steel Finish: Baked enamel or powder coat or Manufacturer's standard chrome plated as directed.

    a. Color and Gloss: As directed.

10. Stainless-Steel Finish: No. 4 directional-satin finish or Manufacturer's standard nondirectional-polish finish as directed.

2.4 POST-AND-BEAM METAL STORAGE SHELVING

A. Post-and-Beam Metal Shelving: Complying with MH 28.2; field-assembled from factory-formed components. Shelves are supported by beams that span between supporting corner posts that allow beam-height adjustment over full height of shelving unit. Provide fixed top and bottom beams, adjustable intermediate beams, and accessories indicated.

B. Load-Carrying Capacity per Shelf: As directed, uniformly distributed.

C. Posts: Fabricated from cold-rolled steel; in shape as directed; with perforations at 1-1/2 inches (38 mm) o.c. to receive beam-to-post connectors.

1. Unit Configuration: Configure shelving units as individual, freestanding or starter- and add-on unit assemblies as directed.
2. Post Base: Cold-rolled steel floor plate, drilled for floor anchors.

D. Beams: Fabricated from cold-rolled steel; in shape as directed. Provide beam at each side of each shelf, with center supports as required for load-carrying capacity of shelf.

1. Beam-to-Post Connectors: Projecting at each end that engage posts as directed.

    a. Top and Bottom Shelf Beams: Provide with single or double beam-to-post connectors as directed.
    b. Intermediate Shelf Beams: Provide with single or double beam-to-post connectors as directed.

2. Beam Quantity: As directed per shelving unit.

E. Particleboard Shelves: 5/8 inch (16 mm) thick; factory or field cut.

F. Flat Metal Shelves: Fabricate fronts and backs or fronts, backs, and sides of shelves with box-formed edges, with corners lapped and welded from the following material:

1. Material: Steel sheet, uncoated or metallic coated as directed.

G. Ribbed-Metal-Decking Shelves: Fabricated from steel sheet.

H. Wire Shelves: Welded steel wire; with 2-by-4-inch (51-by-102-mm) as directed.

I. Accessories:

1. Tie Plates: Cold-rolled steel, finished to match posts; designed for joining posts of adjacent shelving units.
2. Supports: Back-to-wall and back-to-back type that bolt to posts; as required for shelving unit stability.
3. Record Boxes: Knocked-down, corrugated fiberboard with white finish and contrasting contents legend; with pre-punched handles and matching separate lid.

    a. Letter/Legal-Size Boxes: 12-1/2 inches wide by 16 inches deep by 10-1/2 inches high (318 mm wide by 406 mm deep by 267 mm high) for letter-size material stored left to right and legal-size material stored front to back.

        1) Quantity: As directed.

    b. Letter-Size Boxes: 12-1/2 inches wide by 24 inches deep by 10-1/2 inches high (318 mm wide by 610 mm deep by 267 mm high) for letter-size material stored left to right.

        1) Quantity: As directed.

4. Record Box Support Rails: 1-1/2-by-1-1/2-inch (38-by-38-mm) metal angle, with length to match depth of shelving unit; fabricated from same material and with same finish as beams.

J. Steel Finish: Baked enamel or powder coat as directed.

1. Color and Gloss: As directed.

2.5 ANCHORS

A. Floor Anchors: Galvanized-steel, as directed. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

B. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Adjust post-base bolt leveler to achieve level and plumb installation.
4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
5. Install seismic restraints.
6. Connect side-to-side and back-to-back shelving units together as directed.
7. Install shelves in each shelving unit at spacing indicated on Drawings or equal spacing as directed.

    a. Case-Type Metal Storage Shelving: Install adjustable shelf clips at front and back of each shelf.
    b. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.
    c. Post-and-Beam Metal Storage Shelving: Install beams with beam-to-post connectors fully engaged in post perforations.

B. Accessories:

1. Install finished end panels and trim at exposed ends of shelving units.
2. Shelf Dividers: Install as directed.
3. Bins: Install as directed.
4. Shelf-Label Holders: Install one on each shelf.

    a. Install as directed within each shelving unit.

5. Record Box Support Rails: Provide two for each record storage box.

6. Shelf Inlays: Install one per shelf or as directed.
7. Storage Baskets: Install as directed.
8. Back Ledges: Install one per shelf or as directed.
9. Side Ledges: Install on each side of each shelf or as directed.
10. Garment Hanger Tubes: Install as directed.

3.2 ERECTION TOLERANCES

A. Erect case-type and four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

B. Erect post-and-beam metal storage shelving to a maximum tolerance from vertical of 1/4 inch (6 mm) in 84 inches (2134 mm) of height.

3.3 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105613

SECTION 105626 - MOBILE STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated systems.
2. Mechanically assisted systems.
3. Steel-bracket shelving.
4. Steel-case shelving.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1.

C. Shop Drawings: Show shelving layout, location and extent of rail system and clear-aisle widths from face of carriages.

1. Detail fabrication and installation of mobile shelving systems including methods of anchoring shelves to carriages and rails to building structure as required for seismic restraint; coordinate with electrical.
2. Include diagrams for power and control wiring.
3. Include methods of connection for motors and controls and location of electrical rough-in.

D. Samples: For each exposed product and for each color and texture specified.

E. Delegated-Design Submittal: For mobile storage shelving, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Seismic Design Calculations

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Shelf units and accessories.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of mobile shelving systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: As directed Ten or Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated-Design Submittal: For mobile storage shelving, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Seismic Performance: Mobile shelving systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Structural Performance: Provide mobile shelving systems capable of supporting the following:

1. Load per Linear Foot of Carriage: As directed 1000 lb/ft. (1488 kg/m) or 1500 lb/ft. (2232 kg/m).
2. Total Load: As directed load per carriage.

D. Operating Force: For manually operated systems, maximum 1 lbf (4.45 N) required to move 1000 lb (453 kg).

2.2 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard mobile storage shelving systems and components. Where components are not otherwise indicated, provide manufacturer's standard components as required for a complete system.

B. Inserts: Furnish required concrete inserts and similar anchorage devices for installing track system, furnish other components of work where installation of devices is specified in another Section.

C. Flooring: Underlayment thickness required to bring aisle floor finish flush with rail tops.
1. Plywood Underlayment: DOC PS 1, Interior, Underlayment.

a. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84.

2. Particleboard Underlayment: ANSI A208.1, Grade PBU.
3. Ramps: As directed Manufacturer's standard metallic-coated, cold-rolled steel or stainless-steel ramp not steeper than 1:12, with non-slip finish.
4. Floor Finish: As directed Manufacturer's standard level-loop nylon carpet; color as selected by Architect from manufacturer's full range or Manufacturer's standard 12-inch-(305-mm-) square vinyl tile; color as selected by Architect from manufacturer's full range.

D. Tracks: Steel rails with tops machined to mate with guide wheels and with ends designed to provide smooth, secure continuity between sections without field welding. Provide mounting brackets, anchorage devices, adjustable leveling devices, and stops at terminations of rails to prevent carriages from running off track ends.

1. Mounting: As directed Surface mounted or Recessed.

E. Carriages: Rigid frames consisting of C-shaped cold-formed steel beams and cross beams, designed to allow secure anchorage of shelving units.

1. Carriage Width: As directed.
2. Carriage Length: As directed.
3. Wheels: Manufacturer's standard number of bearing-mounted, steel wheels, precision ground to mate with tracks.
4. Bumpers: Provide two rubber bumpers with minimum depth of 1/2 inch (13 mm) each side.

F. Anti-Tip Brackets: Mount on carriage for engagement with track system to secure units against tipping.

G. Carriage End Panels: Full depth and height of shelving units. As directed Provide at the operating end or both ends of each range.

1. Material: As directed, Cold-rolled steel sheet, 0.048 inch (1.22 mm) thick, high-pressure decorative laminate, wood veneer, acrylic sheet or manufacturer's standard.

2.3 MANUALLY OPERATED SYSTEMS

2.4 MECHANICALLY ASSISTED SYSTEMS

A. Drive Systems: Geared transmission and chain systems with tensioning device to provide mechanical assistance and uniform movement along entire length of each carriage. Permanently shielded and lubricated.

B. Drive Shaft: Continuous tubular or solid steel shaft, capable of transmitting torque from drive system without distortion.

C. Locking Pins: Located on range end panels to allow locking of individual range carriage when depressed.

2.5 STEEL-BRACKET SHELVING

A. Steel-Bracket Shelving: ANSI Z39.73, shelving consisting of two uprights and two spreaders per section forming a four-sided frame, with adjustable shelves on one or both sides of uprights cantilever-hung by brackets. Configure units for mounting on mobile carriages.

B. Shelving Units:

1. Type: Welded, self-supporting units.
2. Configuration: As directed, Double or Single-faced units with gusset plates.
3. Width: 36 inches (914 mm).
4. Height: As directed 42 inches (1067 mm), 66 inches (1676 mm), 78 inches (1981 mm), 84 inches (2133 mm) or 90 inches (2286 mm).
5. Shelf Depth: As directed, 8 inches (203 mm), 9 inches (229 mm), 10 inches (254 mm) or 12 inches (305 mm) nominal.
6. Shelf Styles: Provide the following styles and numbers of adjustable shelves:

    a. Flat with integral backstops; As directed, six, five, four or two shelves.
    b. Adjustable divider with integral backstops; As directed, number of shelves. Provide five adjustable partitions per shelf with hooks or tabs to fit in slots in divider shelves.

2.6 STEEL-CASE SHELVING

A. Steel-Case Shelving: Shelving consisting of full end, top, and back panels, with end panels made to receive adjustable shelves in slots or to receive clips to support adjustable shelves. Configure units for mounting on mobile carriages.

B. Shelving Units:

1. Type: As directed Self-supporting, Starter or Adder unit.
2. Configuration: As directed Single or Double-faced units.
3. Width: 36 inches (914 mm).
4. Height: As directed 42 inches (1067 mm), 60 inches (1524 mm), 84 inches (2133 mm) or 90 inches (2286 mm).
5. Shelf Depth: As directed 9 inches (229 mm), 10 inches (254 mm) or 12 inches (305 mm) nominal.
6. Shelf Styles: Provide the following styles and numbers of adjustable shelves:

    a. Flat; As directed six, five, four or two shelves.
    b. Adjustable divider; number of shelves, as directed Provide five adjustable partitions per shelf with hooks or tabs to fit in slots in divider shelves.

2.7 STEEL FOUR-POST SHELVING

A. Steel Four-Post Shelving: Shelving consisting of four angle-iron uprights per section, with adjustable shelves resting on shelf supports hung on uprights. Configure units for mounting on mobile carriages.

B. Shelving Units:

1. Type: As directed Self-supporting, Starter or Adder unit.
2. Configuration: As directed Open, Open with center dividers or Closed back and ends.
3. Width: As directed 30 inches (762 mm), 36 inches (914 mm), 42 inches (1067 mm) or 48 inches (1219 mm).
4. Height: As directed 40 inches (1016 mm), 42 inches (1067 mm), 64 inches (1626 mm), 76 inches (1930 mm) or 88 inches (2235 mm).
5. Shelf Depth: As directed 9 inches (229 mm), 12 inches (305 mm), 18 inches (457 mm) or 24 inches (610 mm) nominal.
6. Shelf Styles: Provide the following styles and numbers of adjustable shelves:

    a. Flat; As directed six, five, four or two shelves.
    b. Adjustable divider; As directed number or shelves. Provide five adjustable partitions per shelf with hooks or tabs to fit in slots in divider shelves.

2.8 MATERIALS

A. High-Pressure Decorative Laminate: NEMA LD 3, Grade VGS.

1. Colors, Textures, and Patterns: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

B. Wood Veneer: Veneer of species indicated, with Grade A faces.

1. Veneer Species and Cut: Red oak, plain sliced.
2. Staining and Finish: As indicated by manufacturer's designations, Match Architect's samples or as selected by Architect from manufacturer's full range.

C. Acrylic Sheet: Thermoformable, monolithic sheet, Finish 1 (smooth or polished).

1. Color: As directed Colorless, transparent, White, translucent, Bronze tinted, transparent or Gray tinted, transparent.

2.9 STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Level and plumb tracks to a tolerance of 0.09 inch in 120 inches (2.4 mm in 3.048 m) with no more than 0.06-inch (1.5-mm) variation between adjacent rails. Use permanent shims or non-shrink grout as indicated by manufacturer.

B. Surface-Mounted Track Systems: Install underlayment, ramps, and finish flooring according to manufacturer's written instructions and flush with track surfaces. Do not extend ramps beyond ends of carriages.

C. Recessed Track Systems: Solidly fill gaps between slab and rail according to manufacturer's written instructions to secure tracks and prevent movement.

D. Carriage Installation: Mount mobile carriages on track system with anti-tip brackets engaged by rails and adjust for smooth operation. Provide non-moving carriages securely fixed to rails where indicated.

E. Attach shelving units to carriages according to manufacturer's written instructions and as required to prevent vibration during movement.

1. Level and plumb shelving units to a tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm).

END OF SECTION 105626

SECTION 107313 - AWNINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed awnings.
2. Manually operated retractable awnings.
3. Motorized retractable awnings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, mounting heights, and attachment details.
2. Detail fabrication and assembly of awnings, including seam layout, spacing, and orientation of awning fabric.
3. Include diagrams for power, signal, and control wiring.
4. Graphics: Show text message, font, character sizes, and other graphic forms; character, word, and line spacing; margin widths; position of copy; and other information related to graphic design.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.

1. Awning Warranty Period: Five years from date of Substantial Completion.
2. Fabric Warranty Period: As directed Three, Five, Eight or 12 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Fire-Test-Response Characteristics: Provide awning fabrics with the fire-test-response characteristics indicated, as determined by testing identical products according to test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: As directed Passes NFPA 701 or California Code of Regulations, Title 19.
2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency for Flame-Spread Index of 25 or less.
3. Permanently attach label to each awning fabric indicating whether fabric is inherently and permanently flame resistant or is treated with flame-retardant chemicals, and whether it requires retreatment after designated time period or cleaning.

2.2 FABRIC

A. As directed.

B. Fabric:

1. Fiber Content: As directed Vinyl-laminated or -coated polyester mesh, Vinyl-laminated or -coated polyester, Acrylic-coated polyester, Resin-coated polyester, Vinyl-coated polyester/cotton blend, Acrylic-coated polyester/cotton blend, Resin-coated polyester/cotton blend, Solution-dyed acrylic, Solution-dyed modacrylic or Expanded PTFE.
2. Weight: As directed.
3. Width: As directed.
4. Mildew Resistance: Showing no growth when tested according to ASTM G21.
5. Applied Treatment: As directed Stain resistant, Mildew resistant, Polymer, flame resistant, Water repellent or Lamination.
6. Pattern and Color: Match Architect's samples, As selected by Architect from manufacturer's full range or as indicated in an awning schedule.

C. Seam Thread: As directed 100 percent expanded PTFE or 100 percent bonded polyester, UV-light, mildew, and rot resistant.

D. Decorative Trims: As directed Borders, Braid and bindings, Cords, Fringe, Patterned edge; scalloped, Patterned edge; V-shaped, Streamers, Tassels or Welting.

1. Colors: As indicated by manufacturer's designations, Match Architect's samples, Matching or coordinating with awning fabric color, as selected by Architect from manufacturer's full range or as indicated in an awning schedule.

2.3 AWNING FRAME AND ACCESSORY MATERIALS

A. Steel:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Steel Tubing: ASTM A500/A500M.
3. Galvanized Steel Tubing: ASTM A787/A787M.
4. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40).

B. Aluminum: Alloy and temper recommended by awning manufacturer for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.

1. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M).
2. Aluminum Extrusions: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, standard weight (Schedule 40).
4. Drawn Seamless Tubing: ASTM B210 (ASTM B210M).

C. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, tamperproof, vandal- and theft-resistant, compatible, nonstaining materials. Provide as required for awning assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maintain uniform appearance; evenly spaced. Where exposed to view, provide finish and color as selected by Architect from manufacturer's full range.

1. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E488 conducted by a qualified independent testing and inspecting agency.

    a. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).

2. Adhesive-Bonded Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E1512 conducted by a qualified independent testing and inspecting agency.

a. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.4 AWNING FABRIC FABRICATION

A. Fabrication: As directed Reinforce wear points and hardware attachment points with nonwoven, mesh or polypropylene mesh webbing. Seam fabrics in locations indicated on the Drawings and as follows:

1. Fabric Edges and Seams: Fold and stitch selvedge and cut fabric edges.
2. Fabric Edges and Seams: Hot cut and sealed.
3. Fabric Edges and Seams: Radio-frequency welded.
4. Fabric Edges and Seams: Adhesively bonded.
5. Fabric Edges and Seams: Manufacturer's standard hemming and seaming methods.
6. Fabric Attachment: As directed Manufacturer's standard. Hem pockets. Screws. Staples.
7. Fabric Attachment: Grommets.

a. Grommet Spacing: 6 inches (150 mm) o.c..

B. Fabric Insets: As directed Heat-sealed or Sewn-in process.

C. Graphic Application: As directed Hand painting, Silk-screen printing, Heat color transfer, Vinyl film with pressure-sensitive adhesive backing, PVDF film with pressure-sensitive adhesive backing, PVF film with pressure-sensitive adhesive backing, Radio-frequency, heat-sealed vinyl film, Eradication or Cut-out lettering.

1. Graphic Image: As indicated on Drawings or as indicated in awning schedule.
2. Text Message: As indicated on Drawings or as indicated in an awning schedule.

a. Text Font: Helvetica.
b. Character Size: Minimum 1-inch- (25.4-mm-) or 1-foot- (0.3048-m-) high characters.
c. Character Colors: As directed.

3. Vinyl Film: As directed, calendered-vinyl film, not less than 3 mils (0.076 mm) thick, with pressure-sensitive adhesive backing, Cast-vinyl film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing or Cast-vinyl reflective film, not less than 2 mils (0.051 mm) thick, with pressure-sensitive adhesive backing.

2.5 FIXED AWNING FABRICATION

1. Frame Fabrication: As directed Fabricate awning frames from steel or aluminum. Preassemble in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations.
2. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
3. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
4. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure awnings in place and to properly transfer loads.

B. Steel Finish: As directed Galvanized mill finish; apply galvanizing repair paint to welds. Manufacturer's standard primed and top-coated decorative or Baked-enamel or powder-coat finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

C. Aluminum Finish: As directed Mill, Manufacturer's standard primed and top-coated decorative or Baked-enamel or powder-coat finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

2.6 MANUALLY OPERATED RETRACTABLE AWNINGS

A. Type: Retractable awning, fabricated form aluminum, with hinged arms attached to steel torsion bar with tensioning system designed to keep fabric taut in any position.

B. Fabric Roll Protection: As directed Cassette design to fully enclose, Semi-cassette design to partially enclose or Sheet metal hood to protect fabric roll when awning is retracted.

C. Manual Operator: Provide gear and crank operator.

1. Manual Operator Assist Mechanism: Manufacturer's standard spring assist for operating heavy awnings.
2. Crank Handle: As directed One or Two, detachable.

D. Mounting Brackets: Configured for mounting to surface indicated, with adjustable pitch.

E. Finish: As directed Manufacturer's standard primed and top-coated decorative or Baked-enamel or powder-coat finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

2.7 MOTORIZED RETRACTABLE AWNINGS

A. Type: Retractable awning, fabricated form aluminum, with hinged arms attached to torsion bar, with tensioning system designed to keep fabric taut in any position.

B. Fabric Roll Protection: Cassette design to fully enclose, Semi-cassette design to partially enclose or Sheet metal hood to protect fabric roll when awning is retracted.

C. Motorized Operator: Provide factory-assembled, motorized, retractable-awning operator designed for retracting awnings of type, size, weight, construction, use, and operation frequency indicated.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

F. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection and internal limit switches; sized by awning manufacturer to start and operate size and weight of awning considering service factor or considering Project's service conditions without exceeding nameplate ratings.

1. Service Factor: According to NEMA MG 1 unless otherwise indicated.
2. Motor Characteristics: As directed Single phase, 24, 110 or 220 V, 60 Hz.
3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
4. Motor Mounting: Within manufacturer's standard roller enclosure.

G. Remote Controls: As directed Electric controls with NEMA ICS 6, Type 1 or Type 4 enclosure for surface or recessed or flush mounting. Provide the following devices for remote-control activation of awnings:

1. Keyed Control Stations: As directed Maintained or Momentary-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
2. Control Stations: As directed Maintained or Momentary-contact, three-position, toggle or rocker-style, wall-switch-operated control station with open, close, and center-off functions.

    a. Color: As directed Ivory, White or as indicated in an awning schedule.

H. Operating Features: Include the following:

1. Backup gear and crank operator for manual operation during power failures with detachable handle, 6 feet (1.8 m) long, manufacturer's standard length, length required to make operation convenient from ground level or length as indicated on Drawings.

2. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop awning at fully raised and fully lowered positions.
3. Preset Position Function: Stop and hold awning at any position or Stop and hold awning at three predetermined positions including open, closed, and one user-programmed position.

I. Finish: As directed Manufacturer's standard primed and top-coated decorative or Baked-enamel or powder-coat finish complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install awnings and motor controls at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.

B. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.

D. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

E. Adjust hardware and moving parts to function smoothly, lubricate as recommended by retractable-awning manufacturer.

3.2 DEMONSTRATION

A. As directed Engage a factory-authorized service representative to train or Train Owner's maintenance personnel to adjust, operate, and maintain retractable awnings.

END OF SECTION 107313

SECTION 107343 - TRANSPORTATION STOP SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular aluminum shelters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For shelters. Include plans, elevations, sections, details, and attachments to other work including anchor-bolt plans and templates.

C. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For anchors, from ICC-ES.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair finish or replace shelters that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Shelters shall withstand the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Design Loads: As indicated on Drawings.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Safety Glazing Products: Category II materials complying with testing requirements in 16 CFR 1201, permanently marked with certification label acceptable to authorities having jurisdiction.

2.2 MODULAR ALUMINUM SHELTERS

A. Fabricate shelters as an integrated set of modular components ready for assembly on Project site.

B. Building Style: Open front, Dual entrance, Single entrance on left, Single entrance on right or as indicated on Drawings.

1. Size: As directed 48 inches by 96 inches (1219 mm by 2438 mm), 60 inches by 120 inches (1524 mm by 3048 mm), 72 inches by 144 inches (1829 mm by 3658 mm) or 96 inches by 144 inches (2438 mm by 3658 mm).

C. Structural Framework: Fabricated from manufacturer's standard 2.5-by-2.5-by-0.125-inch (64-by-64-by-3.18-mm) aluminum tubing, channel, angle, or tee extrusions. Connect framework with exposed mechanical fasteners.

D. Post Bases: Externally adjustable, flanged, aluminum sleeves; minimum 3-inch (76-mm) vertical adjustment. Include shims for leveling.

E. Anchorage: As directed Cast-in-place anchor bolts or Post-installed anchors, fabricated from stainless steel, with allowable load or strength design capacities calculated to be greater than or equal to the design load.

F. Windows: As directed Extruded-aluminum sash frames, factory glazed with clear tempered float glass, tempered, tinted float glass, polycarbonate glazing or acrylic glazing.

G. Roof: As directed Flat, Standing seam hip, Standing seam gable, Glazed barrel vault or Glazed domes with full perimeter gutter.

1. Exterior Roof Panels: Fabricated from 0.032-inch (0.81-mm) thick aluminum sheet with protective plastic sheet finish.
2. Glazing: As directed Polycarbonate or Acrylic.
3. Canopy Fascia: Fabricated from 0.063-inch (1.60-mm) thick aluminum sheet, of manufacturer's standard design.

a. Height: As directed 6 inches (152 mm) or 8 inches (203 mm).

b. Overhang: 3 inches (76 mm).
c. Graphics: Die-cut vinyl lettering for exterior use.

1) Height: 4 inches (102 mm).
2) Color: White.
3) Font: Helvetica.
4) Message: "Bus Stop" or as indicated on Drawings.

4. Downspouts: Integral, extending 3 inches (76 mm) beyond shelter walls.

H. Integral or Freestanding Bench: As directed Aluminum or Wood bench with backrest.

1. Length: As directed Full length of shelter or Partial length to allow wheelchair access.
2. Wood Species: As directed Oak, Maple or Heart redwood.
3. Armrests: Manufacturer's standard pipe armrests.

I. Display Panels: As directed Full width of shelter window by 30 inches (762 mm) or 72 inches (1829 mm) high for one or two-sided display. Front-hinged panel with locking device.

1. Location: As indicated on Drawings or on left sidewall.
2. Illumination: As directed Internal fluorescent or LED lighting for front-lit, back-lit or perimeter-lit display.

J. Shelter Accessories:

1. Ashtray: Wall mounted, stainless steel.
2. Wind Skirts: Aluminum-sheet closures attached to bottom rail and matching shelter finish, full length of walls. Where required for sloping base, overlapping two-piece closures, with bottom anchored to concrete base.

K. Electrical Power Service: 125-A, 120/240-V ac, single phase, three wire. Run copper wiring in 1/2-inch (13-mm) EMT conduit. Exterior weatherproof connection box and lockable interior circuit breaker panel.

L. Photovoltaic Power: As directed Manufacturer's standard photovoltaic power generation system including pole or roof-mounted photovoltaic modules, batteries, charge controllers, inverters, and mounting structures.

M. Lighting Fixtures: As directed Activated by photocell, motion sensor or tamper-resistant concealed switch.

1. As directed One or Two ceiling-mounted fluorescent lighting fixture(s), 48 inches (1219 mm) long, with acrylic lens and two 40-W lamps in each fixture.
2. Ceiling-mounted LED lighting.

N. Heating Unit: As directed Wall-mounted forced-fan operation or radiant, quartz-tube heater, 110 V, enclosed in enameled-steel cabinet. Adjustable timer and vandal-resistant switch with engraved sign: "Push for Heat." Heating capacity of not less than 5000 Btu/h (1465 W).

O. Exhaust Fans: As directed 7-inch (178-mm), 10-inch (254-mm) or 12-inch (305--mm) diameter units, capable of 135 cfm (63 L/s), 520 cfm (245 L/s) or 980 cfm (462 L/s) airflow exhaust.

P. Materials:

1. Aluminum Sheet: ASTM B209 (ASTM B209M).
2. Aluminum Extruded Shapes: ASTM B221 (ASTM B221M).
3. Clear Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, and Quality q3.
4. Tempered, Tinted Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, and Quality q3.

    a. Tint Color: As directed Blue, Blue-green, Bronze, Green or Gray.

5. Acrylic Glazing: ASTM D4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

    a. Color: As directed, Colorless, transparent, White, translucent, Bronze-tinted, transparent or Gray-tinted, transparent.

6. Polycarbonate Glazing: Thermoformable, extruded monolithic sheets, UV resistant, with anti-graffiti coating and with average impact strength of 12 to 16 ft-lb/in. (640 to 854 J/m) of width when tested according to ASTM D256, Test Method A (Izod).

    a. Color: As directed, Colorless, transparent, White, translucent, Bronze-tinted, transparent or Gray-tinted, transparent.

Q. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41, Class I, 0.018 mm or AA-M12C22A31, Class II, 0.010 mm or thicker.

R. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As directed Light bronze, Medium bronze, Dark bronze or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

S. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).

1. Color and Gloss: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install shelters according to manufacturer's written instructions.

B. Set shelters plumb and aligned with full bearing on concrete bases.

C. Fasten shelters securely to concrete base with anchorage indicated.

D. Connect to electrical power.

3.2 ADJUSTING

A. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION 107343

SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum and fiberglass.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated-Design Submittal: For flagpoles.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location as directed.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

B. Exposed Height: As directed.

C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve as directed, made to fit flagpole, for casting into concrete foundation.

2.4 FIBERGLASS FLAGPOLES

A. Fiberglass Flagpoles: Cone or Entasis-tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole as directed.

B. Exposed Height: As directed.

C. Sleeve for Fiberglass Flagpole: Fiberglass or PVC pipe foundation sleeve as directed, made to fit flagpole, for casting into concrete foundation.

2.5 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole or with gold anodic finish as directed.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Swivel snap hooks with neoprene or vinyl covers as directed. Furnish two per halyard.

C. Internal Halyard, Cam Cleat System: 5/16-inch- (8-mm-) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Swivel snap hooks with neoprene or vinyl covers as directed. Furnish two per halyard.

D. External Halyard: Ball-bearing, non-fouling, revolving truck assembly of cast metal with continuous 5/16-inch (8-mm) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: One or Two at each flagpole as directed.
2. Halyard Flag Snaps: Swivel snap hooks with neoprene or vinyl covers as directed. Furnish two per halyard.

2.6 MISCELLANEOUS MATERIALS

A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

B. Sand: ASTM C33/C33M, fine aggregate.

C. Elastomeric Joint Sealant: Joint sealant complying with requirements in Section 079200 "Joint Sealants" as directed.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41 or AA-M12C22A31 as directed.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44 or AA-M12C22A32/A34 as directed.

1. Color: As directed.
2. Color: As directed.

2.8 FIBERGLASS FINISHES

A. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.

1. Color: As directed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

D. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

E. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Or Section 033053 "Miscellaneous Cast-in-Place Concrete" as directed Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107516

SECTION 107523 - WALL-MOUNTED FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall-mounted flagpoles made from aluminum, copper alloy (bronze) and fiberglass.

B. Owner-Furnished Material: None

C. Related Requirements:

1. Section 264113 "Lightning Protection for Structures" for connecting wall-mounted metal flagpoles to lightning protection system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated-Design Submittal: For flagpoles.

1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location, as directed.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

B. Exposed Length: As directed 8 feet (2.5 m), 10 feet (3 m), 12 feet (3.7 m), 15 feet (4.6 m), 20 feet (6 m), 25 feet (7.5 m) or 30 feet (9 m).

C. Vertical Wall Mount: Cast-aluminum mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: As directed Same as flagpole, Gold anodic, Bronze powder coated or Black powder coated.

D. Outrigger Wall Mount: Aluminum mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: As directed Same as flagpole, Gold anodic, Bronze powder coated or Black powder coated.

2.4 COPPER-ALLOY (BRONZE) FLAGPOLES

A. Copper-Alloy (Bronze) Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from seamless pipe or tube complying with ASTM B43 or ASTM B135 (ASTM B135M), Alloy UNS C23000 (red brass, 85 percent copper).

B. Exposed Length: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m) or 40 feet (12 m).

C. Vertical Wall Mount: Cast-copper-alloy (bronze) mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: Same as flagpole.

D. Outrigger Wall Mount: Copper-alloy (bronze) mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: Same as flagpole.

2.5 FIBERGLASS FLAGPOLES

A. Fiberglass Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole.

B. Exposed Length: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m), 40 feet (12 m).

C. Vertical Wall Mount: Cast-aluminum mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: As directed Matching flagpole, Gold anodic, Bronze powder-coated or Black powder-coated.

D. Outrigger Wall Mount: Aluminum mounting bracket complete with escutcheon, mounting plate and through-wall anchorage.

1. Finish: As directed Matching flagpole, Gold anodic, Bronze powder-coated or Black powder-coated.

2.6 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. As directed 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole or with gold anodic finish.
2. 20-oz. (0.70-mm) copper with 23-karat gold-leaf finish.
3. Spun copper alloy, finished to match flagpole.

B. Finial Eagle: Sized as indicated or as standard with manufacturer for flagpole size indicated.

1. As directed Cast aluminum, finished to match flagpole or with gold anodic finish.
2. 20-oz. (0.70-mm) copper with 23-karat gold-leaf finish.

C. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

D. Internal Halyard, Cam Cleat System: 5/16-inch- (8-mm-) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

E. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch (8-mm) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: As directed One or Two at each flagpole.
2. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel or Bronze Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.7 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41 or AA-M12C22A31.

C. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44 or AA-M12C22A32/A34.

1. Color: As directed Light bronze, Medium bronze, Dark bronze or Black.
2. Color: Match Architect's sample or As selected by Architect from full range of industry colors and color densities.

2.8 COPPER-ALLOY FINISHES

A. Hand-Rubbed Finish, Lacquered: Directionally textured, fine satin, mechanical finish coated with lacquer specified for copper alloys, applied by air spray in two coats per manufacturer's written instructions, with interim drying, to a total thickness of 1 mil (0.025 mm).

B. Statuary Conversion Coating over Satin Finish: Directionally textured, fine satin, mechanical finish with sulfide conversion coating.

1. Color: Match Architect's sample.

2.9 FIBERGLASS FINISHES

A. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Mounting Brackets and Bases: Anchor brackets and bases securely to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 107523

SECTION 107526 - ROOF-MOUNTED FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes roof-mounted flagpoles made from aluminum and fiberglass.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated-Design Submittal: For flagpoles. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Seismic Performance: Flagpole assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location as directed.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

B. Exposed Height: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m), 40 feet (12 m), 45 feet (13.5 m) or 50 feet (15 m).

C. Cast-Metal Shoe Base: Made from aluminum for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

D. Hinged Baseplate: Cast-metal tilting hinged base and anchor plate joined by permanently secured pivot rod. Furnish with stainless-steel screws for securing tilting base to anchor plate when not tilted; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

E. Braced Roof Mount: Roof-mounted flagpole socket and either rod or tubular braces with turnbuckles and mounting bases. Provide as a complete assembly with anchor bolts and connector for lightning protection system.

1. Braces, Turnbuckles, and Connectors: Same metal and finish as flagpoles.

2.4 FIBERGLASS FLAGPOLES

A. Fiberglass Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole.

B. Exposed Height: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m), 40 feet (12 m), 45 feet (13.5 m) or 50 feet (15 m).

C. Cast-Metal Shoe Base: Made from aluminum for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

D. Hinged Baseplate: Cast-metal tilting hinged base and anchor plate joined by permanently secured pivot rod. Furnish with stainless-steel screws for securing tilting base to anchor plate when not tilted; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

E. Braced Roof Mount: Roof-mounted flagpole socket and either rod or tubular braces with turnbuckles and mounting bases. Provide as a complete assembly with anchor bolts and connector for lightning protection system.

1. Braces, Turnbuckles, and Connectors: Same metal and finish as flagpoles.

2.5 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. As directed 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole or with gold anodic finish.
2. 20-oz. (0.70-mm) copper with 23-karat gold leaf finish.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

C. Internal Halyard, Cam Cleat System: 5/16-inch (8-mm) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

D. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: As directed One or Two at each flagpole.
2. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.6 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.7 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41 or AAMA 611, AA-M12C22A31.

C. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44 or AAMA 611, AA-M12C22A32/A34.

1. Color: As directed Light bronze, Medium bronze, Dark bronze or Black.

2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.

2.8 FIBERGLASS FINISHES

A. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Baseplate: Install baseplate on washers placed over leveling nuts on bolts, adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

C. Mounting Brackets and Bases: Anchor brackets and bases securely to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 107526

SECTION 107529 - PLAZA-MOUNTED FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plaza-mounted flagpoles made from aluminum and fiberglass.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated-Design Submittal: For flagpoles.

1. Include loads, point reactions, and locations for attachment of flagpoles to building's structure.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location As directed.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

B. Exposed Height: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m), 40 feet (12 m), 45 feet (13.5 m), 50 feet (15 m), 60 feet (18 m), 70 feet (21 m) or 80 feet (24 m).

C. Cast-Metal Shoe Base: Made from aluminum with same finish and color as flagpoles for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

2.4 FIBERGLASS FLAGPOLES

A. Fiberglass Flagpoles: As directed Cone or Entasis-tapered flagpoles fabricated from polyester resin reinforced with woven glass-fiber roving with 75 percent of glass fibers parallel to length of flagpole.

B. Exposed Height: As directed 20 feet (6 m), 25 feet (7.5 m), 30 feet (9 m), 35 feet (11 m), 40 feet (12 m), 45 feet (13.5 m), 50 feet (15 m), 60 feet (18 m), 70 feet (21 m) or 80 feet (24 m).

C. Cast-Metal Shoe Base: Made from aluminum with finish matching flagpole for anchor-bolt mounting; furnish with anchor bolts.

1. Furnish connector to building's lightning protection system conductor.

2.5 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. As directed 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole or with gold anodic finish.

B. Internal Halyard, Winch System: Manually operated winch with control-stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel or Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

C. Internal Halyard, Cam Cleat System: 5/16-inch- (8-mm-) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

D. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: As directed One or Two at each flagpole.
2. Halyard Flag Snaps: As directed Chromium-plated bronze, Stainless-steel, Bronze or Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.6 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

B. Elastomeric Joint Sealant: As directed Multicomponent nonsag urethane, Single-component nonsag urethane or Single-component neutral-curing silicone joint sealant complying with requirements in Section 079200 "Joint Sealants."

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodic Finish: As directed AAMA 611, AA-M12C22A41 or AA-M12C22A31.

C. Color Anodic Finish: As directed AAMA 611, AA-M12C22A42/A44 or AA-M12C22A32/A34.

1. Color: As directed Light bronze, Medium bronze, Dark bronze or Black.
2. Color: Match Architect's sample or as selected by Architect from full range of industry colors and color densities.
3. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 FIBERGLASS FINISHES

A. Fiberglass: UV-light stable, hard, high-gloss gel coat or high-gloss, high-build polyurethane or polyester coating.

1. Color: As indicated by manufacturer's designations, Match Architect's sample or As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Baseplate: Install baseplate on washers placed over leveling nuts on bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

C. Mounting Brackets and Bases: Anchor brackets and bases securely to structural support with fasteners as indicated on Shop Drawings.

END OF SECTION 107529

SECTION 108316 - BANNERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative banners for interior installation.
2. Decorative banners for exterior installation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of banner.

1. Detail colors and graphic layout and content. Show text message, font, and spacing.
2. Show locations for blocking, reinforcement, and supplementary structural support. Identify items that are provided by other trades.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design, fabricate, and install banners to withstand the design wind loads and stresses for under exposure conditions indicated.

1. Design Wind Load: As indicated on Drawings.

B. Fire-Test-Response Characteristics: Passes applicable test method in NFPA 701 as determined by testing identical products by a qualified testing agency.

1. Permanently attach label to fabric of banner assembly indicating whether fabric is inherently and permanently flame resistant or is treated with flame-retardant chemicals and whether it requires retreatment after cleaning or after a designated time period of use.

2.2 FABRIC BANNER

A. Banner Fabric: As directed Nylon, Polyester, Vinyl-coated polyester mesh, Vinyl laminate over polyester or nylon, Vinyl laminate over fiberglass mesh, Cotton, Polyester/cotton blend, Solution-dyed acrylic, Solution-dyed modacrylic or Spun-bonded polyolefin.

1. Fabric Weight: As directed.
2. Height and Width: As indicated on Drawings.
3. Color: As indicated by manufacturer's designations, Match Architect's sample, as selected by Architect from full range of industry colors and color densities or as indicated in banner schedule.
4. Applied Treatment: Stain resistant, Flame resistant, Antistatic, Clear lamination or as directed.

B. Graphics Application: As directed Applique, Hand painting, Silk-screen printing, Heat color transfer, Pressure-sensitive vinyl film, Inkjet, Electrostatic printing, Computer-driven airbrushing, Dye sublimation or Eradication.

C. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Suitable for performance requirements, exposure conditions, and installation methods indicated. Corrosion-resistant or noncorrodible units; tamperproof, vandal- and theft-resistant; and nonstaining to other building materials. Where exposed to view, with finish and color as selected by Architect from manufacturer's full range.

D. Construction: As directed Single or Double-sided banner with block-out fabric.

E. Decorative Trims: As directed Borders, Braid and bindings, Cords, Fringe or Patterned edge; scalloped, Patterned edge; V-shaped, Streamers, Tassels or Welting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install banners at locations and in position indicated, securely connected to supports, in proper relation to adjacent construction, and according to fabricator's written instructions.

END OF SECTION 108316

SECTION 110513 - COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, alternating-current, small and medium, squirrel-cage induction motors, installed at equipment manufacturer's factory, and motors shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 110513

SECTION 111200 - PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Automatic barrier gates.
2. Vehicle detectors.
3. Entry terminals.
4. Exit terminals.
5. Fee computers.
6. Parking facility management software.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For parking control equipment.

1. Include plans, elevations, sections and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media and approved online or cloud solution.

3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 AUTOMATIC BARRIER GATES

A. General: Provide parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than 35 inches (889 mm) above pavement.
   1. Standards: Barrier gate operators that are listed and labeled according to UL 325 by a qualified testing agency.

B. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections. Noncommunicating or Communicating type as directed.

   1. Noncommunicating Type:

      a. Capable of logic for one- and two-way lanes.
      b. Separate momentary contacts for transient patrons, monthly patrons, vehicle entries, and vehicle exits.

   2. Communicating Type:

      a. Real-time communication of lane counts, status messages, and execute commands.
      b. Monitor illegal entries and exits, tailgates, tickets, monthlies, and backouts.
      c. Status messages for gate up too long, backouts, ticket in chute, and gate-arm rebound.
      d. Communication commands for resetting loops, turning "Full" signs on/off, raising and lowering gate arm, and disabling ticket dispensers, card readers, barcode imagers, license plate recognition or automatic vehicle identification as directed.

   3. Physical Characteristics:

      a. On-off power supply switch.
      b. Automatic-manual switch.
      c. Differential counter.
      d. Communication port.
      e. Internal resettable or non-resettable counters as directed.
      f. Thermal-overload protection with manual reset.
      g. Plug-in connectors for two or three vehicle loop detectors as directed.
      h. Thermostatically controlled heater with on/off/auto switch.

i. Thermostatically controlled fan with on/off/auto switch.
j. Switch to test motor and limit switches.
k. Emergency manual disconnect.
l. Battery backup.
m. As directed Single, Two or Four, 115-V ac grounded power receptacle.

4. Operational Characteristics:

a. Able to store successive inputs and sequentially processing each one.
b. Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a zero- to 60-second, variable-time reset device.
c. Directional arming logic.
d. Broken gate-arm monitoring.
e. Programmable automatic timer.
f. Diagnostic mode for on-site testing, with LEDs for inputs and outputs.
g. Automatic and continuous testing of inputs and outputs.
h. Reversible arm capability for right- or left-handed operation.

C. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall (381 mm square by 1016 mm tall). Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.

1. Steel Sheet: Not less than 0.097-inch (2.5-mm) thick, galvanized- steel sheet.

a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

2. Aluminum Sheet: Not less than 0.125-inch (3.2-mm) thick, aluminum sheet.

a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

D. Straight Gate Arm: 1-by-4-inch nominal- (19-by-89-mm actual-) size pine or redwood, 0.097-inch- (2.5-mm-) thick steel, Fiberglass, PVC, or polycarbonate or Aluminum as directed.

1. Traffic-Side Face: Reflective painted finish and black diagonal stripes, Reflective painted finish and red diagonal stripes, Reflective painted finish and black and yellow diagonal stripes or Manufacturer's standard finish and striping as directed.
2. Length: 10 feet (3.0 m), 12 feet (3.7 m) or as indicated on Drawings.
3. Mounting Flange: Provide with breakaway feature to ensure a clean break if arm is struck by vehicle.

E. Folding Gate Arm: Two pieces of 1-by-4-inch nominal- (19-by-89-mm actual-) size pine or redwood joined together with metal side brackets.

1. Traffic-Side Face: Reflective painted finish and black diagonal stripes, Reflective painted finish and red diagonal stripes, Reflective painted finish and black and yellow diagonal stripes or Manufacturer's standard finish and striping as directed.

2. Length: 10 feet (3.0 m), 12 feet (3.7 m) or as indicated on Drawings.
3. Mounting Flange: Provide with breakaway feature to ensure a clean break if arm is struck by vehicle.

F. Operator: UL labeled and listed, Class I, Class II Class III or Class IV as directed. 1/3 or 1/2 hp as directed; number-V as directed, 60-Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through the speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.

1. Opening Time: Three or Six seconds as directed.
2. Inherently adjustable, torque limiting clutch for safety.

G. Characteristics:

1. Audible alarm that activates as part of a safety device system.
2. Additional obstruction detector; noncontact infrared, photoelectric or radio-frequency barrier as directed.
3. Gate-arm warning safety signs on both sides of unit to limit traffic to vehicular traffic.
4. Low-voltage yellow or red warning lights that illuminate when gate is in down position as directed.
5. Low-voltage light on cabinet top that flashes or changes from red to green when barrier gate is operating.
6. LED integrated into gate-arm for increased visibility.
7. Manually operated crank for emergency operation.
8. Authorities having jurisdiction's emergency access as directed.
9. Gate-arm tip support with electromagnetic lock.
10. Gate-arm skirt bottom and top.

2.2 VEHICLE DETECTORS

A. General: Provide detection devices that sense presence or transit of vehicles and emit signals activating gate-arm operators.

B. Vehicle Loop Detector System: Self-tuning electronic presence detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, designed to hold gate arm open until traffic clears. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location indicated on Drawings, as recommended in writing by detection system manufacturer for pave-over or saw-cut installation as directed.

1. Field-Assembled Loop: Wire, in size indicated for field assembly.
2. Factory-Formed Loop: Wire, preformed in size indicated.
3. Operation:

    a. Recognize vehicles within 6 inches (152 mm) of each other on standard-sized loop.
    b. Recognize vehicle direction by detecting vehicle moving from one loop to another.
    c. Generate reverse count if vehicle backs up after generating directional count in forward direction.

d. Continuous diagnostic monitoring and memory for intermittently operating and failed loops.
e. Crosstalk test between adjacent loops.

C. Active Infrared Vehicle Detector: As directed Retroreflective or Emitter/receiver-type presence detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of vehicle in gate-arm pathway by interrupting infrared beam in zone pattern and to emit signal activating gate-arm operator. Include automatic closing timer with adjustable time delay before closing, timer cut-off switch, and vehicle presence detector designed to hold gate arm open until traffic clears.

2.3 ENTRY TERMINALS

A. General: Provide entry terminals with mechanisms, components, and controllers housed in cabinet enclosures.

B. Physical Characteristics:

1. Digital display, touchscreen, or LCD.
2. Time and date display.
3. Time Indicator: 24-hour cycle with A.M. and P.M. or military-time clock mechanism.
4. Voice annunciation.
5. Tickets: Standard paper, Magnetic stripe or Barcode.
6. Removable ticket tray with capacity of 5000 fan-folded tickets.
7. Battery backup for clock and RAM memory.
8. Communication port.
9. Thermostatically controlled heater with on/off/auto switch.
10. Thermostatically controlled fan with on/off/auto switch.
11. Ticket printing and dispensing mechanism.
12. Credit card activation slot, credit card reader with smart card reader, and "Insert Ticket/Card" message.
13. Access card reader.
14. Multiple ticket option for valet parking.
15. Intercom.
16. Pinhole camera.
17. Barcode imager scanner.
18. Proximity access reader.
19. Automatic vehicle identification reader.
20. License plate recognition.

C. Operational Characteristics:

1. Operation: Standalone or Online communication to remote computer as directed.
2. Activation by button with "Push for Ticket" message, vehicle detector, credit card in/out, license plate recognition, automatic vehicle identification, proximity, scanned electronic or hardcopy media or access card as directed.

    a. On activation by button, unit automatically records entry time, license plate, and date on ticket, sounds buzzer, dispenses ticket, and raises barrier gate.

b. On activation by means other than button, credentials are recorded and signal is automatically sent to raise barrier gate.

3. Credit card pay on entry.
4. Automatic ticket validation.
5. Programmable ticket numbering.
6. Programmable facility code.
7. Programmable display.
8. Programmable timer for closing barrier gate.
9. Built-in-service diagnostics.
10. Low-ticket alarm.
11. Out-of-ticket alarm.
12. Ticket jam detection.
13. Test ticket printing.
14. Back-out ticket function.
15. Cancel transaction function.

D. Cabinets: Fabricated from sheet metal with seams welded and ground smooth, approximately 15 inches square by 40 inches tall (381 mm square by 1016 mm tall); consisting of base and top components. Provide single, gasketed access door for each base component with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet. Fabricate top component so it can be unlocked and opened for ticket loading and maintenance. Include flush-mounted lock in rear of top, keyed the same as base component lock.

1. Steel Sheet: Not less than 0.097-inch (2.5-mm) thick, galvanized-steel sheet.

a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

2. Aluminum Sheet: Not less than 0.125-inch (3.2-mm) thick, aluminum sheet.

a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

E. Ticket-Dispensing Mechanisms: Removable assembly, with self-sharpening ticket cutter or ticket burster and plug-in controller.

2.4 EXIT TERMINALS

A. General: Provide exit terminals with controllers and components housed in cabinet enclosures.

B. Physical Characteristics:

1. Digital display, touchscreen, or LCD.
2. Time and date display.
3. Voice annunciation.
4. Battery backup for clock and RAM memory.
5. Communication port.
6. Thermostatically controlled heater with on/off/auto switch.

7. Thermostatically controlled fan with on/off/auto switch.
8. Credit card activation slot, credit card reader with smart card reader, and "Insert Ticket/Card" message.
9. Access card reader.
10. Ticket reader.
11. Receipt printer.
12. Intercom.
13. Pinhole camera.
14. Barcode imager scanner.
15. Proximity access reader.
16. Automatic vehicle identification reader.
17. License plate recognition.

C. Operational Characteristics:

1. Standalone or Online communication to remote computer as directed.
2. Activation by ticket insertion, vehicle detector, credit card in/out, license plate recognition, automatic vehicle identification, proximity, scanned electronic or hardcopy media or access card as directed.
3. Activation results in the following:

    a. Valid Prepaid Exit: Signal is automatically sent to raise barrier gate.
    b. Pay at Exit: Parking fee is calculated and displayed for payment.
    c. Invalid Exit: Activation is rejected and "Pay Cashier First" or "Return to Cashier" message is displayed.

4. Programmable lost ticket function.
5. Display fee.
6. Accept payment by credit card, debit card, smart card, prepaid value card, scanned media and merchant ticket as directed.
7. Accept discounted coupons.
8. Print receipts on demand.
9. Programmable facility code.
10. Programmable grace period.
11. Programmable display.
12. Programmable timer for closing barrier gate.
13. Reports for events and exception events.
14. Programmable merchant validations.
15. Built-in service diagnostics.
16. Cancel transaction function.

D. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall (381 mm square by 1016 mm tall). Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock, all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.

1. Steel Sheet: Not less than 0.097-inch (2.5-mm) thick, galvanized- steel sheet.

    a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

2. Aluminum Sheet: Not less than 0.125-inch (3.2-mm) thick, aluminum sheet.

    a. Finish cabinet, interior and exterior, with manufacturer's standard white or yellow baked-enamel or powder-coat finish as directed.

2.5 FEE COMPUTERS

A. General: Provide modular PC-based system. Register permanent record of each transaction in computer's memory.

B. Physical Characteristics:

1. Touchscreen display.
2. Battery backup for clock and RAM memory.
3. Communication port.
4. Cash drawer or Two cash drawers as directed.
5. Standard ticket reader.
6. Magnetic stripe ticket reader.
7. Barcode ticket reader.
8. Credit card reader with smart card reader.
9. Access card reader.
10. Proximity access reader.
11. Automatic Vehicle Identification reader.
12. License plate recognition.
13. Keyed or Keyless-membrane keypad as directed.
14. Detachable printer.

C. Operational Characteristics:

1. Compute multiple parking fees based on entry times on ticket from ticket dispenser.
2. Compute multiple taxes by percentage and fixed amount.
3. Programmable lost ticket function.
4. Display fee on remote fee display device.
5. Credit card in/out.
6. Accept payment by cash and credit card, debit card, smart card, prepaid value card and merchant ticket as directed.
7. Accept discounted coupons.
8. Control independent cash drawer.
9. Compute change.
10. Print receipts.
11. Print validation on ticket.
12. Print audit trail.
13. Reload value cards.
14. Interface to automatic barrier gate.
15. Programmable with up to six fee structures.
16. Programmable time.
17. Programmable keys.
18. Programmable for special events validations.
19. Programmable for automatic activation for limited date and time validations.

20. Programmable merchant validations.
21. Programmable valet parking.
22. Programmable hotel guest parking.
23. Three levels of security including cashier, supervisor, and master.
24. Recall last transaction.
25. Test mode to verify accuracy of fee structure program.
26. Built-in service diagnostics.
27. View cash audit, revenue, operational, and statistical reports on screen or print on demand.
28. Duress alarm output for emergencies.

D. Cash Drawer: Fabricated with a removable tray and drawer, with five compartments for paper currency and five compartments for coins.

E. Remote Fee Display: Single-faced signs designed for use with fee computer, consisting of 1-inch (25-mm) tall, digital displays or LCDs contained in welded steel bodies with baked-enamel or powder-coat finish.

1. Messages: Amount due, "Thank You," "Closed," and time in A.M./P.M. format.
2. Mounting: Front of cashier's booth or 42-inch- (1067-mm-) high pedestal as directed.

2.6 PARKING FACILITY MANAGEMENT SOFTWARE

A. General: Manufacturer's standard software that is compatible with security-access control system and that provides automatic facility monitoring, supervision, and remote control of parking control equipment from one or more locations.

B. Operation:

1. Collect data for revenue and activity reporting.
2. Collect data for access and space control.
3. Notification services.
4. On-line prepaid parking.
5. Event management.
6. Validation solutions.
7. License plate recognition systems.
8. Pay-by-phone.
9. Loyalty programs.
10. Track tickets.
11. Programmable parking control equipment.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install parking control equipment as required for complete and integrated installation.

1. Rough-in electrical connections.

3.2 INSTALLATION OF AUTOMATIC BARRIER GATES

A. Anchor cabinets to concrete bases with anchor bolts or expansion anchors, and mount barrier gate arms.

1. Install barrier gates according to UL 325.

3.3 INSTALLATION OF VEHICLE DETECTORS

A. As directed Cut grooves in pavement and bury or Bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.

3.4 INSTALLATION OF ENTRY TERMINALS

A. Attach cabinets to concrete bases with anchor bolts or expansion anchors.

1. Connect equipment to remote computer.
2. Load ticket dispenser with supply of tickets.

3.5 INSTALLATION OF EXIT TERMINALS

A. Attach cabinets to concrete bases with anchor bolts or expansion anchors.

1. Connect equipment to remote computer.
2. Load ticket dispenser with supply of tickets.

3.6 INSTALLATION OF FEE COMPUTERS

A. Install computers at locations indicated, including connecting to peripheral equipment and remote computers.

3.7 INSTALLATION OF ELECTRICAL

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: As directed Owner will engage or Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Parking control equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. As directed Engage a factory-authorized service representative to train or Train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 111200

SECTION 111313 - LOADING DOCK BUMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes loading dock bumpers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of loading dock bumper.

B. Shop Drawings: For dock bumpers. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 LOADING DOCK BUMPERS

A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.

B. Laminated-Tread Loading Dock Bumper: Fabricated from multiple, uniformly thick plies cut from fabric-reinforced rubber tires.

1. Thickness: 4-1/2 inches (114 mm) or 6 inches (152 mm), as directed.
2. Horizontal Style: As directed.
3. Vertical Style: As directed.

C. Molded-Rubber Loading Dock Bumpers: Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Shore A durometer hardness of 80, plus or minus 5, when tested according to ASTM D2240.

1. Configuration: As directed.
2. Thickness: As directed.

D. Materials: ASTM A36/A36M for steel plates, shapes, and bars. Hot-dip galvanize according to ASTM A123/A123M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Attach loading dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.

1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
3. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.

B. After completing installation of exposed, factory-finished dock bumpers, inspect exposed finishes and repair damaged finishes.

END OF SECTION 111313

SECTION 111316 - LOADING DOCK SEALS AND SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foam-pad loading dock seals.
2. Frame-type loading dock shelters.
3. Transparent-strip door curtains.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 FOAM-PAD LOADING DOCK SEALS

A. General: Dock seals consisting of fabric-covered foam pads designed to compress 4 to 5 inches (102 to 127 mm) under pressure of truck body.

B. Stationary Head Pad: High and same depth as jamb pads, as directed; beveled; sized for opening width.

C. Adjustable Head Pad: High and same depth as jamb pads, as directed; sized for opening width; with manufacturer's standard hardware and tension spring or counterweight mechanism for adjusting pad height.

D. Jamb Pads: As directed.

1. Nominal Size: 8 inches (203 mm) wide or 12 inches (305 mm) wide, as directed and sized for opening height.

E. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame.

1. Wood Support Frame: Factory-painted, pressure-treated wood; with steel mounting hardware.

2. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish; with steel mounting hardware.

    a. Steel Finish: Hot-dip galvanize components to comply with the following:

        1) ASTM A123/A123M for iron and steel support framing.
        2) ASTM A153/A153M or ASTM F2329 for iron and steel hardware and anchors.

3. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades, make sealing edge of dock seal parallel to back edge of truck. Taper as directed.
4. Guide Strips: 4-inch (102-mm) wide, coated, nylon guide strips on jamb pads.
5. Pleated Protectors: On face of jamb pads of overlapping layers of coated fabric attached to base fabric; As directed, wear exposure.
6. Reinforcing: Manufacturer's standard reinforcing over cover fabric on dock seal, as directed.

F. Materials:

1. Vinyl-Coated Nylon Cover Fabric: Minimum total weight of 22 oz./sq. yd. (746 g/sq. m) or 40 oz./sq. yd. (1356 g/sq. m).

    a. Color: As directed.

        1) High-Visibility Layer: Manufacturer's standard yellow or orange layer.

2. Neoprene-Coated Nylon Cover Fabric: Minimum total weight, as directed.

    a. Color: As directed.

        1) High-Visibility Layer: Manufacturer's standard yellow or orange layer.

3. Hypalon-Coated Nylon Cover Fabric: Minimum total weight of 16 oz./sq. yd. (543 g/sq. m) or 40 oz./sq. yd. (1356 g/sq. m).

    a. Color: As directed.

        1) High-Visibility Layer: Manufacturer's standard yellow or orange layer.

4. Cover Fabric: Manufacturer's proprietary cover fabric.

    a. Color: As directed.

        1) High-Visibility Layer: Manufacturer's standard yellow or orange layer.

5. Pleated Protectors: Same fabric as cover.
6. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
7. Pressure-Treated Wood: DOC PS 20dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA U1; Use Category UC3.

a. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

2.2 FRAME-TYPE LOADING DOCK SHELTERS

A. General: Dock shelters designed to form a seal with sides and top of truck body while leaving entire width and height of truck's rear opening unobstructed.

B. Rigid-Frame Type: Fabricated from fabric-covered or fiberglass side and top panels attached to fixed supporting framework. Provide head and side curtains with built-in flexible stays, wind straps between head curtain and side frame, pleated protectors, reinforcing, and guide strips. Slope head frame from center for drainage. Provide replaceable, fabric-covered, tapered, foam-bottom pads and protective steel bumpers of size and type required for application shown.

C. Flexible-Frame Type: Fabricated from fabric-covered side and top panels attached to retractable supporting framework with independent spring-tension extension arms. Provide head and side curtains with built-in flexible stays, pleated protectors, reinforcing, and guide strips. Provide replaceable, fabric-covered, tapered, foam-bottom pads of size and type required for application shown.

D. Head-Pad Height: As directed.

E. Construction: Fabricate to sizes and shapes indicated or required to fit door-opening sizes shown, allow for not less than 18 inches (457 mm) of truck-body penetration when truck is docked.

1. Wood Framework: Factory painted; mechanically fastened together using nails and lag bolts or metal connectors to form a rigid assembly.
2. Steel Framework: Zinc-plated steel tubing of size and thickness standard with manufacturer, with joints welded.

    a. Steel Finish: Hot-dip galvanize components to comply with the following:

        1) ASTM A123/A123M for iron and steel support framing.
        2) ASTM A153/A153M or ASTM F2329 for iron and steel hardware and anchors.

3. Top and Side Panels: White, translucent fiberglass, 0.045 inch (1.1 mm) thick, weighing 6 oz./sq. ft. (1831 g/sq. m).
4. Top and Side Panels: White, translucent vinyl, weighing 14 oz./sq. ft. (4272 g/sq. m).
5. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades, make sealing edge of dock shelter parallel to back edge of truck. Taper for declined or inclined approach.
6. Guide Strips: 4-inch- (102-mm-) wide, coated, nylon guide strips on side curtains.
7. Pleated Protectors: On head curtain of overlapping layers of coated fabric attached to base fabric.
8. Reinforcing: Manufacturer's standard reinforcing over cover fabric on side curtains and top cover of dock shelter.

F. Fabric:

1. Vinyl-Coated Nylon Cover Fabric: Minimum total weight of 22 oz./sq. yd. (746 g/sq. m) or 40 oz./sq. yd. (1356 g/sq. m).

   a. Color: As directed.

2. Polyurethane-Coated Nylon Cover Fabric: Minimum total weight of 25 oz./sq. yd. (848 g/sq. m).

   a. Color: As directed.

3. Neoprene-Coated Nylon Cover Fabric: Minimum total weight as directed.

   a. Color: As directed.

4. Hypalon-Coated Nylon Cover Fabric: Minimum total weight of 16 oz./sq. yd. (543 g/sq. m) or 40 oz./sq. yd. (1356 g/sq. m).

   a. Color: As directed.

5. Cover Fabric: Manufacturer's proprietary cover fabric.

   a. Color: As directed.

6. Pleated Protectors: Same fabric as cover.

G. Accessories:

1. Buffer flaps.
2. Bottom filler curtain.
3. Bottom seal pads.

2.3 TRANSPARENT-STRIP DOOR CURTAINS

A. General: Door curtains consisting of overlapping strips suspended from top of opening to form a sealed door curtain.

B. Strip Material: Curved, clear, transparent, extruded PVC. Fabricate strips for manufacturer's standard method of attachment to overhead mounting system indicated.

1. Standard Grade: Designed to withstand temperature range of 0 to plus 150 deg F (minus 18 to plus 66 deg C).
2. Low-Temperature Grade: USDA accepted; designed to withstand temperature range of minus 30 to plus 150 deg F (minus 34 to plus 66 deg C).
3. Strip Dimensions: Width and thickness, respectively, as directed.
4. Overlap: As directed.

C. Header Mounting: Angle bolted or welded to opening lintel; equip angle with permanently attached mounting pins and a steel-angle or -plate retaining strip attached to angle with wing nuts.

D. Steel-Plate Wall Surface Mounting: Steel plate bolted to side of lintel; equip plate with permanently attached, threaded, mounting pins and steel-angle or -plate retaining strip attached to plate with wing nuts.

E. Steel-Plate Wall Surface Mounting: Steel pipe attached to side of lintel by manufacturer's standard, winged-U-type suspension brackets.

F. Wall Surface Mounting: Rigid, vinyl, wall-mounting unit bolted to side of lintel above opening; equip unit with a similarly formed, rigid, vinyl retainer attached to unit with wing nuts.

G. Wall Offset Mounting: Angle bolted to face of wall projecting out on each side of door opening to allow hanging strips to clear overhead door hood. Equip angle with permanently attached mounting pins and a steel angle or plate retaining strip attached to angle with wing nuts. Return hanging strips to face of wall at jambs to fully enclose space interior to overhead door.

H. Steel Finish: Hot-dip galvanize components to comply with the following:

1. ASTM A123/A123M for iron and steel support mounting.
2. ASTM A153/A153M or ASTM F2329 for iron and steel hardware and anchors.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Coordinate electrical connections with Division 26 Sections.

3.2 INSTALLATION OF FOAM PAD LOADING DOCK SEALS

A. Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.

3.3 INSTALLATION OF LOADING DOCK SHELTERS

A. Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.

3.4 INSTALLATION OF FRAME-TYPE LOADING DOCK SHELTERS

A. Attach dock shelters securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure an effective seal of dock-shelter curtains with sides and top of truck body when trucks are positioned against dock bumpers.

3.5 INSTALLATION OF TRANSPARENT-STRIP DOOR CURTAINS

A. Transparent-Strip Door Curtains: Attach door-curtain mounting system to lintel with screw anchors or toggle bolts. Mount curtain strips to overlap.

3.6 ADJUSTING

A. After completing installation, inspect exposed factory finishes and repair damaged finishes.

END OF SECTION 111316

SECTION 111319 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Recessed loading dock levelers.
2. Edge-of-dock loading dock levelers.
3. Stationary loading dock lifts (scissor lifts).
4. Truck restraints.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
2. Warranty Period for Hydraulic System: Four or Five years from date of Substantial Completion as directed.
3. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

PART 2 - PRODUCTS

2.1 RECESSED LOADING DOCK LEVELERS

A. General: Recessed, hinged-lip-type dock levelers for permanent installation in concrete pits preformed in the edge of loading platform.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

D. Rated Capacity: As directed Capable of supporting total gross load of 20,000 (9072), 25,000 (11 340), 30,000 (13 608) or 45,000 (20 412) lb (kg) without permanent deflection or distortion.

E. Platform: As directed Not less than 3/16- (5-), 1/4- (6-) or 3/8- (9.5-) inch- (mm-) thick, nonskid steel plate.

1. Platform Width: As directed 72 inches (1829 mm), 78 inches (1981 mm), 84 inches (2134 mm) or as indicated on Drawings.
2. Platform Length: As directed 72 inches (1829 mm), 96 inches (2438 mm), 120 inches (3048 mm) or as indicated on Drawings.
3. Frame: Manufacturer's standard or Clean-pit type, designed to support leveler at sides of pit, with no supports at front of pit floor as directed.
4. Toe Guards: Equip open sides of dock leveler over range indicated with steel toe guards.

a. Toe-Guard Range: Entire upper operating or working range as directed.

F. Hinged Lip: As directed Not less than 1/2 (13), 5/8 (16), ¾ (19) or 1 (25) inch (mm) thick, nonskid steel plate.

1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.
2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.

G. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

    a. Above Adjoining Platform: 12 inches (305 mm), 18 inches (457 mm) or as indicated on Drawings.
    b. Below Adjoining Platform:12 inches (305 mm), 14 inches (356 mm) or as indicated on Drawings.

2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.

    a. Length of Lip Extension: Not less than 12 inches (305 mm) from face of dock bumpers and not less than) 16 inches (406 mm), 18 inches (457 mm), 20 inches (508 mm) or dimension indicated on Drawings measured from ramp edge.

5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
6. Interlock: Leveler does not operate while overhead door is in closed position, leveler night lock is engaged, truck restraint is not engaged, inflatable dock seal is not inflated and inflatable dock shelter is not inflated as directed.

H. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with an upward-biased-spring counterbalancing mechanism controlled by a hold-down device. Ramp raises to top limit of operating range by operating recessed control handle in ramp to disengage hold-down device. Ramp lowers below platform level with lip retracted by operating auxiliary, recessed control handle to release support legs.

1. Free-Fall Protection: Manufacturer's standard protection system to limit free fall of loaded ramps with front edge supported by truck bed.

I. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).

1. Remote-Control Station: As directed Weatherproof single or Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 or Type 12 box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
2. Remote-Control Station with Emergency Stop: As directed Weatherproof multibutton or Multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 or Type 12 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. Ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
    a. Dual-Panel Control Station: Remote-control station for operating side-by-side dock levelers.
    b. Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
3. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.

J. Electric Operating System: Electric control from a remote-control station; motorized operation. Electric activation for raising of ramp and automatic extending of lip. Equip leveler with a packaged unit including a unitized electric motor and shaft assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers.

1. Remote-Control Station: Weatherproof single or single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 or Type 12 box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.
2. Remote-Control Station with Emergency Stop: Weatherproof multibutton or Multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 or Type 12 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. Ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.

K. Air-Bag Operating System: Electric control from a remote-control station; pneumatic operation. High-volume, low-pressure lifting of ramp. Equip leveler with a packaged unit including a PVC-coated, reinforced polyester lifting bag and two-stage, single-speed electric fan of proper size, type, and operation for capacity of leveler indicated. Include dock-leveler supports controlled by release chain for lowering ramp below platform level without extending lip.

1. Remote-Control Station: Weatherproof single or Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.

L. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.

M. Integral Molded-Rubber Dock Bumpers: Fabricated from 4 (102) or 6 (152) inch (mm) thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Shore A durometer hardness of 80, plus or minus 5, when tested according to ASTM D2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.

N. Integral Laminated-Tread Dock Bumpers: Fabricated from 4-1/2 (114) or 6 (152) inch (mm) thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch (19-mm) diameter, steel supporting rods that are welded at one end to 1/4-inch (6-mm) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.

O. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
3. Steel Tubing: ASTM A500/A500M, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

P. Dock-Leveler Finish: Manufacturer's standard prime-paint or baked-on factory finish, Hot-dip galvanized or Spray zinc metallized.

1. Toe Guards: Baked-on factory finish.

Q. Accessories:

1. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch (13-mm) diameter by 6-inch (152-mm) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming spray zinc metallized steel form system for poured-in-place construction of concrete pit.

3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
4. Side and rear weatherseals.
5. Foam insulation under dock-leveler platform.
6. Abrasive skid-resistant or Smooth surface.

2.2 EDGE-OF-DOCK LOADING DOCK LEVELERS

A. General: Surface-mounted, hinged-lip-type, edge-of-dock levelers designed for permanent installation on face of loading dock platform.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

D. Rated Capacity: Capable of supporting total gross load of 20,000 (9072), 25,000 (11 340), 30,000 (13 608) lb (kg) without permanent deflection or distortion.

E. Platform Ramp Width: 66 inches (1676 mm), 72 inches (1829 mm), 78 inches (1981 mm), 84 inches (2134 mm) or as indicated on drawings.

F. Hinged Lip: Not less than 3/8 (9.5), 7/16 (11) or ½ (13) inch (mm) thick, nonskid steel tread plate.

1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.

G. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

    a. Above Adjoining Platform: 5 inches (127 mm), 6 inches (152 mm) or as indicated on drawings.
    b. Below Adjoining Platform: 5 inches (127 mm) or as indicated on drawings.

2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 3 inches (76 mm) over width of ramp.
4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.

a. Length of Lip Extension: Not less than 12 inches (305 mm) from face of dock bumpers and not less than 15 inches (381 mm), 17 inches (432 mm) or dimension indicated on drawings measured from ramp edge.

5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs. Leveler shall be capable of retracting to stored position while truck is at loading dock.

H. Mechanical Operating System: Manual control; counterbalance and spring operation. Spring-operated raising and walk-down lowering of unloaded ramp. Equip leveler with a torsion-spring counterbalancing mechanism controlled by a hold-down device.

1. Lever Handle: Self-storing lever handle for raising unloaded ramp with minimal lifting force by pulling lever back to extend lip and pushing lever forward to lower ramp and lip.
2. Removable Lifting Handle: For raising unloaded ramp by lifting action.

I. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).

1. Remote-Control Station: Weatherproof single or Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 4 or Type 12 box. Ramp and lip raise to vertical position and extend to truck bed by depressing and holding button.

J. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- and formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.

K. Integral Molded-Rubber Dock Bumpers: Fabricated from 4 (102) or 6 (152) inch (mm) thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Shore A durometer hardness of 80, plus or minus 5, when tested according to ASTM D2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.

L. Integral Laminated-Tread Dock Bumper: Fabricated from 4-1/2 (114) or 6 (152) inch (mm) thick, multiple, uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch (19-mm) diameter, steel supporting rods that are welded at one end to 1/4-inch (6-mm) thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.

M. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
3. Steel Tubing: ASTM A500/A500M, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

N. Dock-Leveler Finish: Manufacturer's standard prime-paint or baked-on factory finish, Hot-dip galvanized or Spray zinc metallized.

O. Accessories:

1. Self-forming pan.
2. Cast-in-place design.
3. Run-off guards.
4. Ramp approach plate.
5. Interlock to truck restraint or Key switch.

2.3 STATIONARY LOADING DOCK LIFTS

A. General: Stationary, scissors-type, single-leg, hydraulic dock lift.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: MH 29.1.

D. Rated Capacity: Lifting capacity of not less than 8000 lb (3629) kg) or load indicated on drawings with axle loads of 6500 lb (2948 kg) at ends and 5000 lb (2268 kg) at sides or magnitudes indicated on drawings.

E. Platform: Nonskid, safety-tread or Smooth-surface heavy hot-dip galvanized steel deck plate.

1. Platform Size: 72 inches (1829 mm) long by 72 inches (1829 mm) wide, 96 inches (2438 mm) long by 72 inches (1829 mm) wide, 120 inches (3048 mm) long by 72 inches (1829 mm) wide or as indicated on drawings.
2. Platform Guarding: Bevel toe guards, Toe sensor, Indicator bar, Skirts or Enclosure to comply with requirements in MH 29.1.
3. Removable or Fixed Guard Rails: Provide steel, hot-dip galvanized-steel or aluminum guard rails on two sides of platform with a single, removable chain across each end. Provide guard rails not less than 39 inches (991 mm) high with midrail and 4-inch (102-mm) high, kick plate at bottom. Mount rail sockets flush with platform surface.

F. Bridge: Nonskid, safety-tread steel or Nonskid, safety-tread, hot-dip galvanized-steel or High-tensile aluminum plate.

1. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty

lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.

2. Size: 18 inches (457 mm) long by 60 inches (1524 mm) wide, 18 inches (457 mm) long by 72 inches (1829 mm) wide or as indicated on drawings.
3. Locations: Ends, Sides or as indicated on Drawings.

G. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel and Travel Speed: As indicated on Drawings.
2. Vertical Travel: Maximum of 60 (1524) inches (mm) from a lowered height of 12 (305) inches (mm) for a total raised height of 72 (1829) inches (mm) or as directed.
3. Travel Speed: Nominal raising speed of 8 (0.04), 10 (0.05) or 12 (0.06) fpm (m/s).
4. Hinged Throw-over Bridge Operation: Manual, Spring assist, Manual-assist bridge winch or automatic powered.

H. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.

1. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.

    a. Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
    b. Equip reservoir, valve manifold, and pressure line with oil-line filters.

2. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement-plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.

    a. Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.

3. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12 box.

    a. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

I. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.

1. Scissors Mechanism: Fabricate leg members from heavy, hot-dip galvanized steel-formed tube or plate members to provide maximum strength and rigidity.

2. Scissors Configuration: Single leg, Multiple width or Multiple length.
3. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
4. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
5. Mounting: Surface or Pit.

J. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
3. Steel Tubing: ASTM A500/A500M, cold formed.

K. Dock Lift Finish: Manufacturer's standard baked-on factory finish unless otherwise indicated.

2.4 TRUCK RESTRAINTS

A. General: Manufacturer's standard device designed to engage truck's rear-impact guard and hold truck at loading dock.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: Comply with MH 30.3.

D. Rated Capacity: Capable of supporting total gross load of 30,000 (13 608) or 32,000 (14 515) lb (kg) without permanent deflection or distortion.

E. Operating Range: Capable of restraining rear-impact guards within a range from:

1. Vertical Range: Minimum of 7 inches (178 mm), 8 inches (203 mm), 9 inches (229 mm), 11 inches (279 mm) or dimension indicated on drawings to maximum of 28 inches (711 mm), 30 inches (762 mm), 34 inches (864 mm) or dimension indicated on drawings above driveway.
2. Horizontal Range: Zero to 10 inches (254 mm), 12 inches (305 mm), 15 inches (381 mm) or dimension indicated on drawings in front of dock bumpers.

F. Power Operating System: Manufacturer's standard electromechanical or hydraulic unit.

1. Remote-Control Station: Single-button station of the constant-pressure type, enclosed in NEMA ICS 6, Type 12 box. Restraint is engaged by depressing and holding button; restraint is released by releasing button.
2. Interlock: Leveler does not operate while truck restraint is not engaged.

G. Mechanical Operating System: Restraint operates by use of a lifting rod or hook to raise engagement device.

H. Rear-Impact-Guard Sensor: Detects presence of rear-impact guard and automatically returns to stored position if rear-impact guard is not engaged.

I. Caution Signs: Exterior, surface mounted; designed to inform both dock attendant and truck driver; with sign copy as follows. Provide one sign at each truck-restraint location.

1. Sign Copy in Forward and Reverse Text: Manufacturer's standard text permitting truck movement with green light.
2. Interior Sign Copy: Manufacturer's standard text permitting truck movement with green light.

J. Light Communication System: Red and green illuminated signal-light sets, with lens approximately 4 inches (102 mm) in diameter, designed to indicate status to both dock attendant and truck driver. Equip system with steel control panel located at interior of dock that includes illuminated lights indicating or indicates status of exterior signal lights. Provide signal-light set and control panel at each location indicated for light communication system. Enclose exterior signal-light sets in steel or plastic housing with sunshade.

1. Manual Operation: System is activated by push button or switch located on interior or truck-restraint control panel.
2. Automatic Operation: System is activated automatically by limit switch, photoelectric sensor or magnetic switch mounted on overhead door track. Provide on-off switch located on light communication system or truck-restraint control panel.
3. Automatic Operation: System is activated automatically when device engages rear-impact guard. Provide on-off switch located on truck-restraint control panel.
4. Mounting: Wall, Driveway, Pit or Pedestal.

    a. Pedestal: 4 by 4 inches (102 by 102 mm) post with base plate and face plate for mounting light communication system, 60 inches (1524 mm) high.

        1) Finish: Manufacturer's standard baked-on factory finish in yellow or orange or Hot-dip galvanized.

K. Alarm: Audible and visual system indicating that rear-impact guard is not engaged, with manual reset.

L. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
3. Steel Tubing: ASTM A500/A500M, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

M. Truck-Restraint Finish: Manufacturer's standard electrodeposited zinc coating or Hot-dip galvanized.

N. Accessories: Interlock to dock leveler or Key switch.

2.5 FINISH REQUIREMENTS

A. Finish loading dock equipment after assembly and testing.

B. Hot-Dip Galvanizing: Comply with the following:

1. ASTM A123/A123M for iron and steel loading dock equipment.
2. ASTM A153/A153M or ASTM F2329/F2329M for iron and steel hardware for loading dock equipment.

C. Spray Zinc Metallizing: ASTM B833.

D. Electrodeposited Zinc Coatings: ASTM B633.

E. Steel Prime Paint Finish: Clean, pretreat, and apply manufacturer's standard primer.

F. Baked-on Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

1. Color: Manufacturer's standard or Match Architect's sample.
2. Toe Guards: Paint to comply with ANSI Z535.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install loading dock equipment as required for a complete installation.

1. Rough-in electrical connections.

3.2 INSTALLATION OF RECESSED LOADING DOCK LEVELERS

A. Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

3.3 INSTALLATION OF EDGE-OF-DOCK LOADING DOCK LEVELERS

A. Attach dock levelers to loading dock platform in a manner that complies with requirements indicated for arrangement and position relative to top of platform.

1. Weld anchor holes in contact with continuous embedded loading dock edge channel. Weld or bolt bumper blocks to face of loading dock.

3.4 INSTALLATION OF STATIONARY LOADING DOCK LIFTS

A. Attach dock lifts securely to loading platform, floor of recessed pit or surface of driveway.

3.5 INSTALLATION OF TRUCK RESTRAINTS

A. Attach truck restraints in a manner that complies with requirements for arrangement and height required for device to engage vehicle rear-impact guard. Interconnect control panel and signals with dock leveler.

1. Wall-Mounted Units Weld or Anchor.

    a. Weld truck restraints to steel curb angle, edge channel or mounting plate embedded in loading dock edge.
    b. Anchor truck restraints to face of loading dock with expansion anchors and bolts.

2. Driveway-Mounted Units: Anchor truck restraints to driveway with expansion anchors and bolts.
3. Pit-Mounted Units: Anchor truck restraints to concrete pit with expansion anchors and bolts.

3.6 ADJUSTING

A. Adjust loading dock equipment to function smoothly and safely, lubricate as recommended by manufacturer.

B. Test dock levelers for vertical travel and adjust to maintain operating range indicated.

C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train or train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION 111319

SECTION 111323 - PORTABLE DOCK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable loading dock lifts (scissors lifts).

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For portable dock equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PORTABLE LOADING DOCK LIFTS (SCISSOR LIFTS)

A. General: Portable, scissors-type, single-leg, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standard: MH 29.1.

D. Rated Capacity: Lifting capacity of not less than 8000 lb (3629 kg) or load indicated on Drawings as directed and with axle loads of 6500 lb (2948 kg) at ends and 5000 lb (2268 kg) at sides or magnitudes indicated on Drawings.

E. Platform: As directed Nonskid, safety-tread or Smooth-surface heavy hot-dip galvanized-steel deck plate.

1. Platform Size: 72 inches (1829 mm) wide by 72 inches (1829 mm) long, 72 inches (1829 mm) wide by 96 inches (2438 mm) long, 72 inches (1829 mm) wide by 120 inches (3048 mm) long or As indicated on Drawings.
2. Platform Guarding: As directed Bevel toe guards, Toe sensor, Indicator bar, Skirts or Enclosure to comply with requirements in MH 29.1.
3. Removable or Fixed Guard Rails As directed: Provide steel, hot-dip galvanized-steel or aluminum guard rails on two sides of platform with a single, removable chain across each end. Provide guard rails not less than 39 inches (991 mm) high with midrail and 4-inch (102-mm) high, kick plate at bottom. Mount rail sockets flush with platform surface.

F. Bridge: Nonskid, safety-tread steel, Nonskid, safety-tread hot-dip galvanized-steel or High-tensile aluminum plate as directed.

1. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.
2. Size: 18 inches (457 mm) long by 60 inches (1524 mm) wide, 18 inches (457 mm) long by 72 inches (1829 mm) wide or as indicated on Drawings.
3. Locations: Ends, Sides or as indicated on Drawings.

G. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel and Travel Speed: As indicated on Drawings.
2. Vertical Travel: Maximum of 60 (1524) inches (mm) from a lowered height of 12 (305) inches (mm) for a total raised height of 72 (1829) inches (mm).
3. Travel Speed: Nominal raising speed of 8 (0.04), 10 (0.05) or 12 (0.06) fpm (m/s) as directed.
4. Hinged Throw-over Bridge Operation: Manual, Spring assist, Manual-assist bridge winch or Automatic powered as directed.

H. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.

1. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.

    a. Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
    b. Equip reservoir, valve manifold, and pressure line with oil-line filters.

2. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.

    a. Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.

3. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12 box.

    a. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.

I. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.

1. Scissors Mechanism: Fabricate leg members from heavy, hot-dip galvanized steel-formed tube or plate members to provide maximum strength and rigidity.
2. Scissors Configuration: Single leg, Multiple width or Multiple length as directed.
3. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
4. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.

J. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
3. Steel Tubing: ASTM A500/A500M, cold formed.

2.2 FINISH REQUIREMENTS

A. Baked-on Factory Finish: Provide unless otherwise indicated. Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

1. Toe Guards: Paint to comply with ANSI Z535.1.

B. Hot-Dip Galvanizing: Comply with the following:

1. ASTM A123/A123M for iron and steel portable dock equipment.
2. ASTM A153/A153M or ASTM F2329/F2329M for iron and steel hardware for portable dock equipment.